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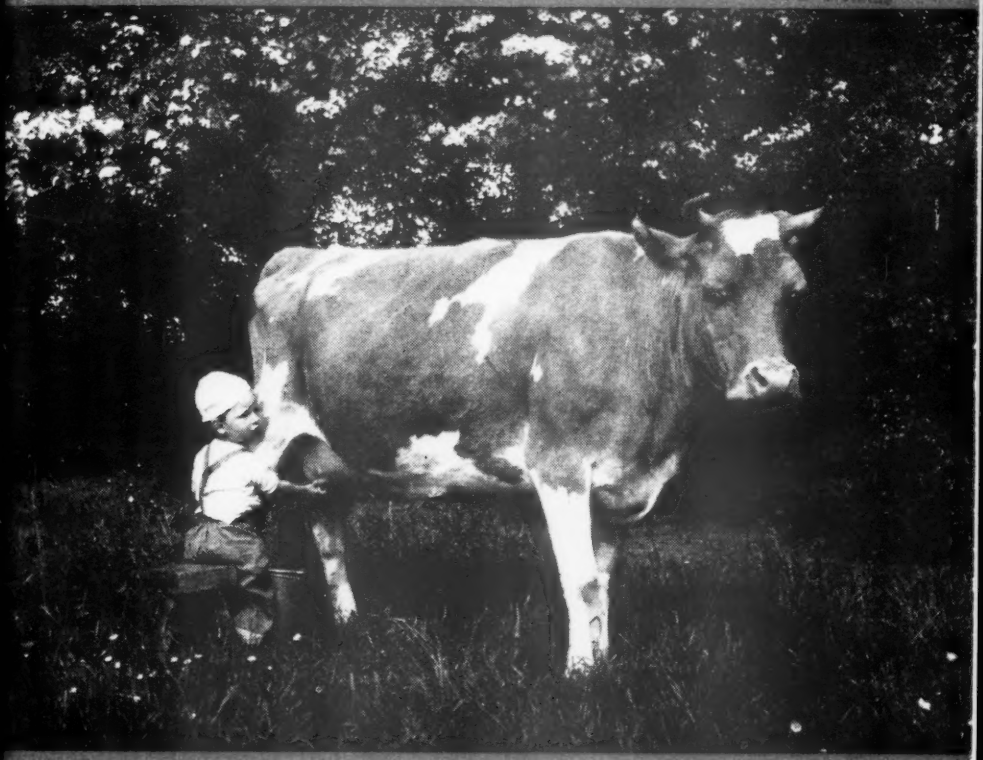

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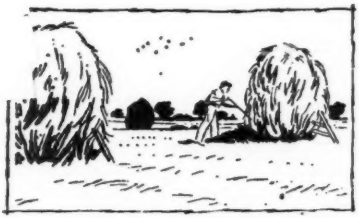

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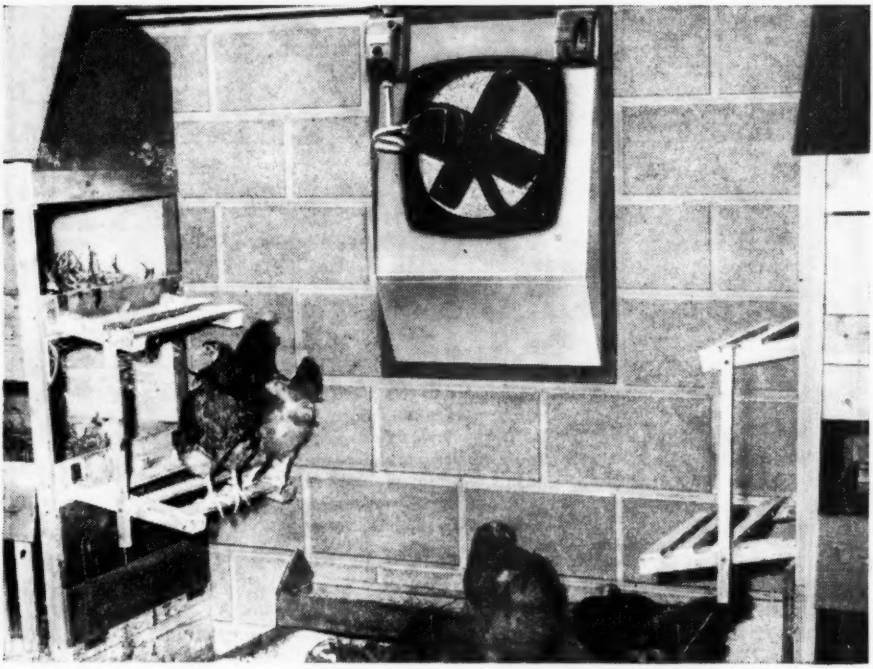

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1.0 cfm. per lb. liveweight

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Cover photograph: Boy on a man's job *Photo:* H. D. Keilor

Capital Investment in Horticulture

L. G. BENNETT, PH.D.

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The Government's Horticultural Improvement Scheme comes into force this month. Dr. Bennett considers some of the problems which may arise, and the management implications of proposed improvements.

THE coming into force of the Horticulture Improvement Scheme gives a topical interest to the problems of capital investment in horticulture. As a result of Part I of the Horticulture Act, 1960, £8 million will be available over the next five years to assist the industry, in the form of capital grants towards the cost of improvements sanctioned by the Ministry.

There are said to be 70,000 producers of horticultural crops in Britain, though by the terms of the Act a number will not come within the Scheme. Thus, all businesses with less than four acres of land (or its equivalent in glasshouses and frames, etc.) are excluded. Moreover, to qualify under the Scheme a business must occupy land which for two years immediately preceding the application for aid has been used for the commercial production of horticultural crops. Land used for growing annual vegetables in the open will be included in the qualifying area of a business to the extent that more than two horticulture crops have been grown in succession on one-half its area in the two years preceding the application. Just how much these conditions will affect the number of holdings or growers who are eligible it is impossible to say. But two types of holding will present problems to those responsible for administration.

The first covers those small holdings which have some lights or cloches or glasshouses, but are just too small to qualify. For instance, a three-acre holding with a glasshouse 25 × 87 feet would just rank as a four-acre holding. Without such a glasshouse it would need a quarter of an acre of cloches or lights to rank for assistance; but for some holdings a few panes of glass more or less will make all the difference between inclusion and exclusion. There is also a special problem facing occupiers of those holdings which fail to qualify on grounds of size, and this will be mentioned later.

The second type covers those relatively extensive holdings which do not carry one crop of any kind, let alone a horticultural crop, on the whole of the acreage each year. Studies suggest that there are many such holdings. When the very extensive cropping is coupled with the fact that such holdings often grow maincrop potatoes, and sometimes a small area of corn (crops which put the acreage on which they grow outside the Scheme), then it will be hard to decide whether a holding is a horticultural holding or not within the meaning of the Act. The position may be further complicated by fallow land, but the acreage qualification will apply to land used for growing horticultural produce at the time of the application.

The intention of the Act, however, is clear. It is to help only relatively intensive horticultural holdings which are large enough to give the occupier a reasonable livelihood. But carrying out this intention will not always be an easy and straightforward task.

Administrative problems will only rarely be of direct concern to the grower seeking aid; he will have problems of his own to deal with. For this reason all growers should be familiar not only with the provisions of the Scheme, but also with the contingent economic and managerial problems with which the operation of the Scheme will present them. This note is mainly concerned to bring five of the more important points to the notice of growers.

Grower must find two-thirds of the cost

The first is that only one-third of the cost of approved projects will be met by a capital grant, which will usually be an outright payment but may in some cases be paid by instalments. The immediate consequence for the grower, of course, is that he will have to find two-thirds of the cost out of his own resources, or by borrowing, and may even have initially to find almost the whole cost. Thus, for the industry fully to enjoy the whole of the £8m by way of grant it will have to find further capital to the extent of £16m. By no means all growers who would benefit most by extra capital or whose need for capital is greatest will be able, or indeed willing, to find the money.

By way of illustration, let us take a hypothetical example. A grower with a block of glasshouses of good design and good repair, but heated with out-of-date apparatus, desires to install steam heating at a cost of £3,000. If his proposal were approved he would get a grant of £1,000 and have to provide £2,000 himself. The annual extra costs he would incur *on account of the new capital alone* would be approximately £248, if interest had to be paid at 5½ per cent and the capital was to be redeemed in ten years. If the whole capital cost had fallen on the grower, his annual extra costs would have been £372. The crux of this first point, however, is that the grower has to find a sum of £2,000 as well as meet all the charges to which the borrowing of this gives rise.

The second point has to do with the productivity of the investment. Clearly, to justify the investment of a further £2,000 there must either be savings of cost or greater productivity. A saving of £250 a year in the cost of running the new system as compared with the old by more economical use of fuel, less labour in stoking and so forth would justify the investment. It would also be justified if it led to an increased yield of two or three tons of tomatoes, or extra earliness, or some other factor such as a higher proportion of better grades of produce. The important point is that some estimate should be made of the minimum advantage which would be necessary to offset the extra costs which the new investment entails.

As a result of the Act, the Government, as well as the growers, is investing in horticulture, and the schemes which will be aided must be such that they would be justified even if the whole cost fell on the growers. Indeed, if the likely gain were only just sufficient to meet the costs after they had been reduced by the grant, then the long-term value to the growers would be open to question, and such schemes stand no chance of approval.

Thirdly, let us consider the use of resources other than fixed capital. Suppose, for instance, that a grower could advance the season of his tomato crop by six weeks or two months by a better heating system. He would need extra working capital to buy extra fuel for a longer heating season, he might well need more labour, and he might have to adopt some form of seedling illumination and a more effective system of pest and disease control if the new fixed investment were to justify itself. He would certainly have to master the new and more exacting techniques which the full and profitable use of his new asset would demand.

Improvements within the Scheme—and outside it

My fourth point has to do with the kinds of project which rank for aid, and the relative value of these and others for which assistance would not be given. The general intention of the Act is clearly to improve the circumstances under which home-grown produce is marketed, and only incidentally to aid production. Examination of the White Paper explaining the Act shows that there are two types of improvement in aid of which grants may be made. The first could be described as landlords' improvements, and the second as the building or installation of specific equipment to aid marketing. Thus, the first category includes the provision of new buildings (except glasshouses),* the removal of hedges and the filling in of ditches and other impediments to production. The second includes the provision of cold stores, washing and grading machinery and so on.†

But there are many other forms of fixed capital investment in horticulture, such as a water supply for irrigation purposes, new glasshouses or frames, and heating systems for glass at present unheated. These and similar production-intensifying processes are outside the scope of the Scheme, but nevertheless worthy of consideration by those growers who are investing more capital—and that means all those who seek aid under the Horticulture Improvement Scheme. Growers must therefore weigh up the relative advantages to them in their own particular circumstances of the two kinds of investment, the full-cost projects which fall outside the Scheme and the reduced-cost projects which come within it. If, for instance, the gain from spending £2,000 on an irrigation scheme were greater than the gain from a £3,000 glasshouse heating scheme with a net capital cost of £2,000, then it will be better to forgo the grant and proceed with the unaided project.

As the Scheme will run for five years, those growers with holdings too small to qualify at present could presumably, by erecting more glass or laying down frames or cloches, bring their holdings within the Scheme and still have three years in which to benefit from grants. This is the special problem facing the small grower, and clearly some careful capital budgeting, including the consequences of the unaided investment to increase the effective size of the holding, is called for if the correct course of action is to be chosen and the fullest possible benefit obtained.

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* A limited area of new glass would rank for aid on holdings below 7 acres with less than 675 square feet of glass at present.

† As an exception, improved heating systems for glasshouses also rank for aid.

Look before you leap

The fifth and last question is: can we estimate the likely advantage of different projects. It would, for instance, be possible to forecast relatively accurately the net financial advantage of a new heating system for a block of glasshouses. The consumption of the old in terms of fuel and man-power, the cost of repairs and the annual depreciation would be known, and the costs of the new would not be difficult to ascertain. But the purchase of a grading or vegetable washing machine could well be an act of faith, the financial consequences of which were problematic. Nevertheless, it would be salutary to calculate the size of financial gain in terms, say, of shillings a bushel for the throughput handled which would just meet the cost of the new equipment. At best the grower would have some measure of the possibilities for gain which the new equipment offered; at least he would know in retrospect whether his move had been correct.

Although the Horticulture Improvement Scheme is the part of the Horticulture Act which will have the most direct and immediate impact on growers, this must not be allowed to obscure the fact that it is only a facet of a larger plan. First and foremost, it appears to provide a way by which growers and growers' co-operatives can equip themselves with the means of presenting produce to the market in an orderly fashion—and do so relatively cheaply. But the Government will not only be investing £8m in the industry for this purpose. It will also set up the Horticultural Marketing Council, and intends under other legislation to reorganize Covent Garden Market.

The import duty remains the chief instrument of aid which the Government apparently intends to give the industry, and remains the feature on which growers place most reliance. But the facilities available under the new Act must go some way towards helping the grower to make the best of the circumstances which the existing import duties create for him.

Approach to Hay and Silage

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More feed does not necessarily mean more, or better, milk. The relationship is not as simple as that. But the quality of the feed is most important. Prof. Jones discusses some of the differences between good and poor hay, and the effects of feeding good grass and silage on milk quality and output.

IF plants grew as fast during January and February as they do in May and June, there would be no need to conserve any crop for use during the winter. But they do not: even our kales and cabbage, that are so useful during January and February, have had to make their growth in the preceding six months.

During the summer, grass is easily the most economic source of nutrients for the ruminant stock, and if the farmer has more than his stock wants at that time, the conservation of the surplus will help to meet his needs during the winter. Such grass would usually be conserved in the form of hay or silage. But these are not "end products" in themselves: they both have to be converted into an animal product—meat or milk.

The approach to the production of hay and silage should therefore be based on the requirements of the livestock—the cattle and sheep. This entails not only storing a sufficient *quantity* of the fodder, but also ensuring that the conserved product is suitable for the purpose the farmer has in view, which means that its *quality* is of very considerable importance. We should therefore look first at what controls the quality, and then see how that quality in the fodder determines the production by the animal.

Plant and animal

During their lifetime all crop plants, if left undisturbed, pass through the stages of leaf, stem and eventually seed production. Grass is no exception: it is most suitable as a feed for the high producing animal when still in the leaf stage—particularly if the whole of the crop is to be consumed.

When the grass plant is allowed to proceed to the stem-forming stage, it is given the opportunity to break down much of the very valuable proteins and carbohydrates that were built up in the leaves to grow its own stem—a fibrous structure eventually destined to support the seed head. This is a pretty serious loss for the animal, for the essence of its nutrition is that it takes from the plant what the plant was preparing for itself. Naturally, the animal thrives much better when it gets the products from the leaf before they have been used by the plant.

There is another serious loss from the animal point of view when the plant puts up a stem. That stem consists very largely of fibre—a tough material which often becomes a liability, because it absorbs *from* the animal more energy for its digestion than it eventually supplies *to* the animal when digested. Moreover, with foodstuffs that contain a high proportion of fibre, the animal's intake of food per day is limited by the amount of fibre it can deal with in that time.

It has been a popular idea for a long time that the cow's feeding capacity is closely tied up with the amount of dry matter she can take in a day—3 lb per cwt live weight is the accepted figure. In actual feeding practice, however, I have found the average cow will consume only about 20 lb dry matter as hay made towards the end of June, when grass consists predominantly of stem, whereas she will take in as much as 30 lb dry matter as silage made at the succulent leafy stage during the first half of May. Note here that the amount of water in the fodder is not the limiting factor as long as it does not exceed the twelve gallons a day which the cow needs in any case.

Two sacrifices

To produce milk, the cow has to sacrifice from her own body system the protein, carbohydrate and fat that goes into the milk itself, but in addition she has to sacrifice a roughly corresponding amount to convert those three

ingredients from their plant forms into their animal forms. This second sacrifice is really a "burning up" process which takes place inside her body and is accompanied by the emission of heat. If she is producing upwards of five gallons of milk a day, this heat will be sufficient to maintain her body temperature. If she is producing less than two gallons a day, the heat produced in the conversion process needs to be supplemented by burning some extra protein and carbohydrate over and above that used in the conversion process itself.

Here I want to put in a plea that the animal's capacity for production—whether of meat or milk—should be used to the full. It is wasting the capital tied up in the cow to allow her to milk at the two-gallon level when she is capable of producing five gallons.

From practical feeding trials I have found that an ordinary-sized cow can comfortably consume up to 7 lb of fibre a day, but beyond that point the excess fibre becomes a liability and indeed soon becomes the factor limiting her food intake. Our aim should therefore be to cut the grass at such a stage that the cow can take sufficient protein and carbohydrate in the grass (as conserved) to provide at least for the four-gallon yield by the time her food intake reaches that limit of 7 lb of fibre. This in effect means cutting the grass at a very high quality stage—the leaf stage at which she normally grazes the pasture in May, or the aftermath later in the summer. When cut at such a stage and conserved with the minimum of deterioration, the grass can keep the cow going and enable her to produce four gallons a day without any other foodstuffs by way of concentrates being added to it. I believe this is the stage we should aim at; then silage will no longer be looked upon as roughage to be balanced with something better, but regarded as the complete food in the winter months, just as fresh grass is a complete food in the summer months.

Influence of feed on the quantity of milk

Now let us look at the cow. An increase in her intake of food is expected to show a corresponding increase in the output of milk immediately. Such a response of output being proportional to intake would occur if the cow were a mere machine—receiving nutrients from the digestive system and passing them directly into the udder. The cow, however, is not just a machine. Any proteins and carbohydrates she takes in have to become part of her own body system before they influence the amount of milk that she gives. Thus the output on a particular day is only very remotely controlled by the amount of nutrients that she has absorbed on the same day.

The amount and quality of the milk she gives that day are governed by the condition of her body system and the pressure within that system towards pushing out a portion of its reserves in the form of milk. This "pressure" is not the result of that day's intake, but rather is it the result of the condition which has been built up within her during the previous interval of anything up to two months. In practice, the output of milk of high yielding cows on any particular day can be increased *by withholding* part of their ration for that day. It is not true, however, to say that the intake of food by the cow on any particular day has no influence on the output of milk. It definitely has a direct influence, but it is a case of *more food less milk for that day.*

The cow's condition pressure determines her output of energy on a given

day. That energy has then to be shared between the udder producing milk and the stomach dealing with food. If the animal is in perfect health the process of digestion takes priority, and so more food to cope with means less energy left over for the production of milk during that day.

In this matter of using up energy for digestion, it is the fibre content of the feed that seems to have the dominating influence, and any fibre over and above that necessary to satisfy the needs for cudding can cause a serious loss in the production of milk. Hence the need for supplying grass with a low fibre content *if* we wish that grass (as pasture or silage) to provide the major portion of the proteins and carbohydrates for milk production.

How feed influences the quality of milk

So much for the influence of the feed on the quantity of milk produced. Another important question today is how the animal's feed influences the quality of its milk.

The analysis of milk is based on three divisions—fats, water and the rest (generally referred to as S.N.F.—solids-not-fat). The percentage of any one of these divisions is therefore increased if there is a reduction in either of the other two.

Heredity plays a great part in determining the proportions of the three constituents that any particular animal puts out in her milk. The ratio of these three to one another for any particular animal is not fixed, however. On the contrary, the percentage of each varies with her age and period of lactation; the ratio is also influenced by the level of feeding of the animal, and particularly by the kind of food.

Food with a high fibre content tends to reduce the output of each of the three constituents. On the other hand, foods rich in protein and soluble carbohydrates tend to increase the total output of each. But the significant fact is that the cow's output of each constituent does not increase or decrease at the same rate. Fat is the slowest to respond; water is the quickest; and the rate of increase or decrease in the S.N.F. is between the two.

So if the cow's daily ration is improved by increasing the quantity of protein and soluble carbohydrates, in the course of the next six weeks she steps up her production of each of the three constituents, with the water being increased more than the fat. *The percentage of fat* in her milk will thus be lower, in spite of the fact that the *total quantity of fat* she is putting out per day is higher. This frequently happens when a farmer is trying to push up a herd with a normal three-gallon average to the five-gallon level.

If one goes in the opposite direction, increasing the cow's consumption of fibre (roughage), the total daily production of each of the constituents (fat, S.N.F. and water) is reduced, with the water being the quickest to react and fat the slowest. Hence though the actual quantity of fat put out by the cow in a day has dwindled, the percentage of fat in the milk is higher.

According to the analyst's figures the feeding of more fibre is thus regarded as beneficial, and it is interpreted as a method of improving the quality of milk. What the analyst's figures do not show is the reduction in the gallonage of milk that goes with the improvement in its quality, the gallonage being the vital figure so far as the farmer's cheque is concerned.

The essence of maintaining both quantity and quality in the milk supply is,

therefore, to keep up the level of feeding the cow so that she has plenty of reserves in her body of the proteins, carbohydrates and fats. In this way she can be kept at a uniformly high level of production, without the need for forcing her up with extra protein in her feed and running the risk of the fat not keeping step with the other ingredients in the milk. In fact the dairy cow must be built up before calving with a sufficient reserve of protein as flesh (fit, not fat) to provide for a high level of milk when she calves, and thus obviate the need for feeding overmuch protein during the initial weeks of her lactation to raise production at the expense of quality.

Protein values of different feedingstuffs

This brings us to the question of how to provide a suitable level of protein in the cow's ration throughout the year. The essential point is to get into the dairy cow the quantity of proteins and carbohydrates necessary to provide for the milk she will be expected eventually to give. If the cow is to maintain her production at the four-gallon level, she needs about 3 lb of protein (measured as protein equivalent) a day to provide for her own body activity plus the four gallons of milk. That 3 lb of protein equivalent can be obtained as protein in grass or in cake, but its cost per pound in the grass (as hay or silage) will be only one quarter of its cost in the cake.

People frequently calculate then how much of the hay or silage needs to be fed to provide the 3 lb of protein equivalent, in the hope that they can compensate for the lower protein content of the grass by increasing the grass ration. Here is where the cow refuses to obey the calculator. He would want her to double her consumption of the hay. But she cannot do so, if that brings the amount of fibre above what her digestive system can accommodate and deal with in a day. With ordinary hay, that limit (about 7 lb of fibre per day) will be reached before she has taken in more than a quarter of her protein needs, and thus, if we want four gallons of milk a day, we are forced to rely on the feeding of concentrates, although the protein is far more costly per pound as cake than as grass.

The protein in seed (the main constituent of cake) is therefore at a premium because of its relative freedom from fibre. Thus it is not the cost per pound of protein that should receive first consideration, but how much of the necessary protein and carbohydrates we can get into the cow each day if she is to produce milk economically.

This is where the quality of the grass product comes in; if the grass for winter feed is cut at the stemmy stage it will be so high in fibre that the cow can get very little of her protein requirement from it, never mind how cheaply the hay is made. Grass cut at the leafy stage, however, contains far less fibre, and *if no other fibrous food is consumed by the cow*, she can obtain the 3 lb of protein in the form of *grass leaf* before reaching her limit of fibre.

Judge feedingstuffs on freedom from fibre

Hence each pound of protein equivalent accompanied by a moderate proportion of fibre, as in the grass leaf, is worth many times a corresponding pound of protein equivalent with a high proportion of fibre, as in the stem, the stage to which grass is allowed to develop before it is cut for hay. The

evaluation of a foodstuff should therefore be based not so much on the total amount of protein and carbohydrate present in it, as upon the freedom of those useful constituents from being cluttered up with so much fibre as to limit their usefulness for high production by the animal. Grass at the usual hay stage cannot enable a cow to produce four gallons of milk a day without having another feedingstuff of extremely low fibre content to go with it—the expensive concentrate based on the seeds of a plant. On the other hand where grass is cut at the leafy stage—at which it would need to be conserved as silage rather than as hay—the protein can be so high and the fibre so low that the cow can take in the necessary 3 lb of protein before the 7 lb of fibre is reached. Thus grass conserved at this young stage can constitute the sole ration of the four-gallon cow without resort to the use of any cake, a situation that reduces the cost of the feed *without* reducing the yield of milk. This in turn makes an appreciable reduction in the cost of production per gallon.

In trying to economize on the cost of feeding the dairy cow, an attempt is often made to introduce silage as *part* of her ration. The protein thus supplied in the silage is expected to replace not the protein in the hay, which is cheap, but the protein in the cake, which is expensive. The cake ration is therefore reduced but the hay is still fed *ad lib*.

Almost invariably there is a reduction in the milk yield. This is probably the most frequent method of introducing silage, and so the silage gets into disfavour from the very beginning. In such a trial the very essence of the cow's limitations has been ignored. After allowing her to fill herself almost to capacity with the fibre of the hay, which of course she enjoys and may even take for preference, she is now offered the protein and carbohydrates from silage (a leaf product) instead of from cake (a seed product). The seed product is almost devoid of fibre and thus the cow can take it in addition to the hay, but the leaf product (silage) has quite a lot of fibre, and the cow cannot take much as an addition to the hay. Hence the protein intake is reduced, and eventually down goes the amount of milk produced. The plain fact is that leafy silage should not be regarded either as a concentrate or as roughage, but as a complete food in itself. The fibre in quality silage does not act as a deterrent to intake until the cow reaches the four-gallon stage, *if* there is no other fibrous material within her reach. Note again the *if*.

When to cut for conservation

The quality of grass as measured for milk production undergoes a colossal deterioration while it is standing from mid May until the end of June. In May it is at the silage stage—all leaf, but in June it is at the hay stage with its usual complement of stem. At mid May the fibre content is only twice that of protein, whereas by the end of June the fibre content is ten times that of protein (the protein content in each case being measured in the usual way as protein equivalent).

The true value of silage made at the *high quality stage* has, unfortunately, not been given the attention it deserves in our attempts to provide a suitable winter ration for the dairy cow. To enable grass to be fully used as a winter feed, it should be cut at the leafy stage at which it would have been grazed during the summer months, and not when the leaf has almost disappeared

and been replaced by stem. Present practice is to cut the grass at the maximum bulk stage and *then correct* for its lack of quality by buying (or growing at home) those very expensive products needed to go with it. Henceforth the aim will be to cut the grass at such a stage that it will make, *on its own*, a complete ration for the ordinary four-gallon cow in the winter, just as it does now during the summer months. If we miss the target, and some other food has to be added to the silage, then the addition should have a low fibre content—not hay or straw.

Quick Haymaking

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We are happy to publish Mr. Culpin's stimulating address to the National Power Farming Conference for the benefit of all those readers who were unable to get to Cheltenham on 10th February.

IN spite of the great progress in silage-making in the last few years, the amount of permanent grass and temporary leys made into hay in Britain still far exceeds the amount conserved by all the other processes put together. The quantity made annually in England and Wales alone is still usually well over five million tons, and represents one of the most important items in agricultural production. Unfortunately, not all of this five million tons is good hay. Indeed, it would not be going too far to say that in an average year quite a high proportion of it is of poor quality. The value of good hay is widely recognized by farmers, but since the years of depression between the world wars there has been a tendency to take the view that making good hay is almost entirely a question of luck with the weather, and that therefore there is little to be gained by detailed studies of the process, or by practising the techniques that such studies show to be useful. This attitude is, however, one that is rapidly disappearing. Haymaking, like so many other farm jobs, is being successfully revolutionized on a few progressive farms—by the use of mechanical power to speed up old jobs, and also by the use of complex machines to carry out new ones. I believe that the time is now ripe for a widespread application of some of the lessons that have been learned.

Before considering some details of haymaking methods I must remind you that it is impossible to make good hay out of low-quality material. The way in which the nutritive value of grass and clover crops falls with increasing age is well known, but the fact is that a high proportion of the crop is cut when it is already well past its best. Very young grass is unfortunately much more difficult to make into hay than a more mature crop. The early flowering stage in a quickly growing crop is, however, usually a reasonable aim.

Very heavy crops are always more difficult to make into good hay than moderate or light ones. Moreover, the weather early in the season is usually

less favourable for rapid drying than it is towards midsummer. For these reasons it is usually best to shut up fields for hay fairly late in the season—after some early grazing. Fields that produce dense, heavy crops early in the season are much better made into silage.

Make use of weather forecasts

There is no deep mystery about haymaking. It is just a drying process, and because nutrients such as sugars and proteins contained in the crop deteriorate rapidly in moist conditions, speed of drying is the essence of success. Another reason for trying to secure rapid drying is that losses from respiration of the crop continue at a high rate until the moisture content is below 60 per cent, and do not cease until it is reduced below about 40 per cent. The nearer we can approach to the speed of grass drying, the better. It need hardly be said that if drying has to be done entirely by "natural" means, the process is necessarily very dependent on the weather. Machines can enable the best to be made of what drying weather there is, but cannot dry crops in the rain. "Make hay while the sun shines" is as good an axiom today as ever it was. In fact, the more effort that is put into haymaking, the more important it becomes to know all that can be learned about the weather which lies ahead. This means that more than ordinary attention should be paid to official weather forecasts. It is true that they are not always accurate, but farmers who have tried using the "fine spells" forecasts issued specially for those who pay a small fee, find that these forecasts, which are notified by individual telegrams, can be of great help in deciding when to cut.

Cutting the crop

Some farmers still regard hay cutting as a reasonable job for a wet day, when work such as beet hoeing cannot be done. The crop falls very flat behind the mower, and it may then be left for days, during which most of the readily available sugars disappear, and the hay remains as wet as it was when cut. Nothing can be said in favour of such practices, which are the opposite of quick haymaking, and almost invariably result in severe losses of nutrients. Quick haymaking, on the other hand, calls for cutting when the crop is externally dry, and there is a forecast of at least a short fine spell. If there is a good deal of hay to be made, a two-day fine spell may have to suffice, and cutting must start as soon as the dew has gone on the morning the forecast is received.

In an adverse season, it may sometimes be necessary to do some cutting when it is known that there is an appreciable risk of showers, since it is not practicable to wait indefinitely for a fine forecast. The amount cut should always be limited to what can be made into hay and collected within a short period. On most farms 10–20 acres will be as much as can be managed at a time, and after a decision to cut is made, the sooner the cutting is finished, the better. It will therefore pay to put in more than one mower if this can be arranged. There must, of course, be a succession of cuts on large farms, and success in quick haymaking depends almost as much on the farmer's skill in getting fields ready in succession as it does on the actual making of the hay. It is not worth while to shave the ground when cutting. If a stubble

about two inches long is left, the tedder works better, the hay dries better, and the aftermath comes away more rapidly.

A five-feet cut mower typically absorbs about three horse-power, so there is a good deal to be said for doing more than operate one such mower when a modern tractor is being used. Developments that I hope to see include putting an electrically or hydraulically driven cutter-bar in front of the tractor in addition to the usual one at the side or rear. I hope we shall also see many useful combinations of mowers and machines for swath treatment rapidly perfected. There is much to be said for ensiling the headlands of hay fields, so that it is not necessary to try to make hay along hedgerows and beneath trees. If this has been done it is often worth while to cut the field in lands, measuring out accurately, striking through at about 50-yard intervals, and then casting and gathering 25-yard strips as in systematic ploughing. This facilitates all subsequent haymaking operations.

Swath treatment

One of the fundamental requirements of quick haymaking is to start the drying immediately the crop is cut, and to make this drying proceed right through the swath as uniformly as possible. Unfortunately, an ordinary mower usually leaves the swath lying very flat, so that drying can take place only on top. It is therefore essential to break and loosen up the swath as quickly as possible after cutting. It is already a common practice in some parts of Switzerland, where haymaking is difficult, to use a single-row p.t.o.-driven tedder behind the tractor at the same time as the crop is cut by a side-mounted mower. The least that should be done is to loosen the swaths up with a swath turner. When two tractor mowers are used, if one is a side-cut machine it can pull a light swath turner and loosen up the two previous swaths as it cuts.

1959 was an extraordinary haymaking season, and it produced some extraordinarily rapid drying, especially after drastic swath treatment by means of flail-type forage harvesters, combine harvesters and machines designed specifically for the job, such as roller crushers. We must not expect such highly favourable results from drastic swath treatment in a normal season, but I am convinced that we shall find considerable benefit even in normal seasons from the use of either roller crushers or crimpers, and that we can expect a rapid extension of the use of these machines. The extent of their popularity and the speed of their adoption will, however, depend on the development of moderately priced outfits, and until these arrive there is a good deal to be said for sticking to the use of swath turners and tedders, or perhaps using a specially modified and adjusted forage harvester for the first tedding treatment, after using an ordinary mower to cut.

Most farmers who in 1959 tried using flail-type forage harvesters to cut the hay crop were pleased with the quick drying, but some suspected that they were losing a considerable amount of leaf. The possible extent of such losses are indicated by a trial on one of the Ministry's experimental husbandry farms, Drayton, where the weight of a red clover crop collected after cutting with a flail-type harvester was approximately half of that obtained by normal quick haymaking methods. On another experimental husbandry farm, Great House, where the crop consisted mainly of grasses, the loss of

weight from using a forage harvester was about 22 per cent. It is difficult to envisage the possibility of a useful bruising by this type of mechanism without appreciable fragmentation losses, especially where the machine is used to cut the crop, rather than for swath treatment after mowing; and it is for this reason that I consider roller crushers or crimpers more likely to become established haymaking machines.

There is so much difference between a good technique of haymaking using tedders, and the method of masterly inactivity that is still widely practised in Britain, that I am a little doubtful about the need to jump straight from the latter to cutting with flail-type forage harvesters. However, I realize that there are thousands of farmers who would be delighted if they could discard their mowers, and I should be sorry if anything I said deterred anyone from trying out new methods. What I suggest, therefore, is that farmers who intend using their forage harvesters for haymaking next year should be careful to set the machines to give the smallest possible chopping effect, and should do their best to make a simple comparison with a quick haymaking technique using a tedder. Use of the pick-up baler makes it not too difficult to arrive at a quantitative as well as a qualitative comparison.

Many different types of roller crushers are now being used on a fairly wide scale in the U.S.A., where the crops treated usually consist mainly of lucerne or clover. It remains to be seen whether crimpers, corrugated rollers, rubber-covered rollers or plain steel rollers will give the best results here, but it seems likely that crimpers will prove best for crops composed mainly of grasses. An essential feature of a good machine is a high-speed roller mechanism, so designed as to ensure that the crop passes through in a thin layer. It is generally agreed that for roller crushers to be effective they must be used before the crop has wilted; and the best arrangement is probably to cut one swath and crush the previously cut one simultaneously.

Whatever the first swath treatment, the subsequent treatment should consist of tedding to ensure that drying continues as rapidly and uniformly as possible. It is not possible at present to say with any certainty that one type of tedder is better than another, but there does seem to be some advantage in recently developed p.t.o.-driven machines that are capable of taking the crop round and over the cylinder if desired. However, excellent work can be done with a combination of a mounted 2×2 finger-wheel swath turner/side-rake and a good p.t.o.-driven tedder of either forward- or back-action type. The important point is to use them often enough—at least once a day, and twice or more if drying is rapid. Fortunately these modern machines work best at high speed, so a good deal of ground can be covered in a short time.

Though "hay in a day" was possible on a few days last year, it is only in exceptionally good drying weather that the crop will be fit for baling by the end of the day after cutting, and more often the drying will need to continue into the third day. It is here that barn drying can be a valuable aid—enabling the crop to be taken in a day or so earlier, before wet weather intervenes.

There is a widely-held belief that if rain falls after early tedding or more drastic treatment has been applied, the results are disastrous. It is true that continuous rain after drastic swath treatment can sometimes cause severe losses or even a complete loss of the crop, but this is unusual. After a shower, the crop should be tedded as soon as it is dry on top, and if this is done, experience shows that it need not be lost even if the showery weather con-

tinues over a lengthy period. In careful experiments both at the N.I.A.E. and at one of the Ministry's experimental husbandry farms, Trawscoed, it has been found that after being wetted by a shower, a crop that was previously drier due to swath treatment will dry again more rapidly than a comparable crop which did not receive the swath treatment.

Use of pick-up balers

The use of pick-up balers for haymaking has passed through several phases in the short time since the technique was first tried a little over twenty years ago, but there can be little doubt that baling will be the chief method for several years to come. At first, the pick-up baler was hailed as a wonderful machine for quick haymaking—capable of producing sweet, green hay, with little loss of leaf. When, however, the machines were first tried on a fairly wide scale in Britain, the results were poor, for reasons that are now obvious. To begin with, we had got out of the habit of effective swath treatment, and the hay was seldom uniformly dried. Moreover, the early machines usually formed tight bales that made it very difficult for further drying in the bale to take place. The natural reaction to this was to make sure that the crop was thoroughly dry when baled. This often meant leaving it out for weeks, with the result that the end product was often just a collection of unpalatable and indigestible stems. We are now re-learning the art of haymaking, and are discovering how best to use the greatly improved pick-up balers that are now available; and the result is that the claims made for pick-up baling over twenty years ago are at last being substantiated.

The first essential for baling is that the crop must be uniformly dried, with no wads of very damp herbage that will start to heat when they get into the bale. Thorough swath treatment should ensure this uniformity.

The next important point is to have a reasonably uniform windrow. A six-wheel finger-wheel side-rake is as good as most machines at producing this, and the method of working the field in lands helps to avoid difficulties. Most ram-type balers work best at a high speed with a fairly small windrow, whereas roll-type balers need a thick windrow that is as near rectangular in section as possible.

Bale early in unsettled weather

If a crop has been uniformly dried but is still at rather a high moisture content and rain seems likely, it is usually better to bale rather than attempt to get the crop fully dried in the windrow. This does not, of course, mean that I recommend baling at very high moisture contents. Material that is baled at a uniform 35 per cent moisture content can make very good hay without forced drying, provided the bales are made and treated in such a way as to facilitate this. The bales must be made reasonably loose, and to ensure that they do not fall to pieces on drying it is well to reduce the length of bales made in a ram-type machine to about 30 inches where this is practicable, as on many modern machines. A bale $14 \times 18 \times 30$ inches baled at 30–35 per cent moisture content should not weigh more than about $\frac{1}{2}$ cwt, and it should be just possible to push a hand into the bale after it is released from the bale chamber. At a moisture content in the region of 25 per cent, full-

length bales weighing up to about 70 lb may be made. What we very much need is a good hay moisture meter suitable for farm use, for it is very difficult to judge moisture content.

I hope that it will soon be possible to develop a type of pick-up baler that needs less watching and adjustment as conditions change. At a given setting with machines at present available, the damper the crop, the tighter the bale formed will be—the reverse of what is really needed. I wonder if it is too much to hope that we can soon get a baler that turns out bales of a constant length and weight at a given setting. I believe that this is the aim of one of the latest American balers, which incorporates a hydraulic control device. The N.I.A.E. is collecting basic information on the pressure developed in the bale-forming process, and it is to be hoped that the results will be of value in the development of improved bale-forming mechanisms.

Treatment after baling

An interesting and important subject for study and discussion is treatment and handling of the bales after they leave the machine. Except in the case of roll-type bales it is surely folly to let them fall singly. Most farmers now use a sledge to collect them into small groups, and having gone to this trouble it seems to me to be a sensible step to go a little further and cover the tops of the heaps of bales with some form of waterproof cap. Groups of a dozen bales of good quality hay can be worth as much as £5, and if they must stay out in the field for even a few days it will usually pay to cover them with simple sheets made of fertilizer bags or polythene. The idea that bales do not take up rainwater has been clearly disproved by work at the N.I.A.E. Square bales in stooks, or as left by a sledge, will often absorb well over 10 per cent of their weight in water. It is true that the method of stacking is important, but even bales stacked with the convex end up will take in a good deal of moisture. I believe that barn drying or "conditioning" is the ultimate solution for this finishing process in our fickle climate, but there is also probably considerable scope for developing methods of stacking the bales on rough stillages, which will not only keep them off the ground but will also make their subsequent collection easy. I envisage the possibility of arranging these stillages in lines across the fields, in such a way that it would be a simple matter to provide some form of waterproof cover. It may be necessary to keep the cover more or less clear of the tops of the heaps in order to eliminate "sweating".

There is one other method of handling damp bales that must be mentioned, if only on account of its simplicity. Some farmers cart them to a Dutch barn and stack them at once, knowing full well that the stack will heat and sweat, and covering the top with a good layer of straw to take up the moisture and prevent the top of the hay from moulding. The hay sometimes gets quite hot, and in so doing must lose some of its feeding value; but the resulting hay is sweet, and present indications are that with such baled crops the danger of excessive heating is very small. Some who practise the technique go so far as to say that baled hay will never heat to the point of spontaneous combustion. We are looking into this question, and hope to know within a few years whether this is fact or fancy.

In conclusion, I should like to qualify what I said at the beginning con-

cerning attitudes to haymaking, by paying a tribute to men like Stephen Williams and others who have devoted a great deal of study and practical experiment to the improvement of haymaking, and who by their example have helped to make it possible to bring about a great and rapid improvement in the general standard of quality of baled hay. The work of these pioneers is backed up by and partly based on a wealth of scientific data painstakingly put together by research workers at the N.I.A.E. and elsewhere. "Quick haymaking" is therefore a technique which can be thoroughly recommended.

Indoor Farrowing

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In hard weather, out of doors or in poor indoor farrowing houses, almost half the piglets born alive may be lost. Good indoor farrowing can cut these losses to a steady 7–10 per cent throughout the year.

LOSSES in piglets exceed those of any other young livestock by a fairly large margin. In fact, about one in five piglets born alive perishes, the great majority being lost in the very early days of their existence. Not surprisingly, therefore, a good deal of attention has been given to the housing requirements of the piglet by the farmer, the adviser and the research worker. It is very pleasing to record that from all sides conclusions can be given which are complementary to one another and enable us to make certain recommendations on piglets' environmental needs.

Why indoor farrowing? In general, the best conditions can be provided for the piglets, the sow, and the attendant when farrowing is done indoors in specialized accommodation. It should be emphasized that the greatest losses in piglets come from crushing and chilling, and it is to prevent these that so much care is needed in designing the farrowing pen. At the same time, however, permanent quarters always present a great potential disease risk, and it is important to try to show how we can best meet the dual needs of hygienic quarters and correct environment in a farrowing house.

Temperature needs

Above all, the newly born piglet needs guaranteed warmth, and by this we mean air temperatures of between 70°F and 80°F. The piglets are then comfortable, and their body temperature can be maintained at the usual figure of approximately 103°F, although they are not protected by a coat or plentiful layers of fat. The lighter a piglet, the more important is the maintenance of this rather high temperature; so housing conditions must often be expected to make good deficiencies in the breeding or feeding of the parent stock. It also helps to coax the piglets away from the sow, and so lessen the risk of crushing, if the temperature of 70–80° is maintained in a nest or creep while the temperature of the farrowing house itself is rather lower; from

50–60° is generally a suitable range. Also the difference between nest and house will harden the piglets to the environment they may eventually experience.

Temperatures of 70°F to 80°F are not easily reached, and remarkably few piglet nests maintain such conditions uniformly. Probably the greatest boon to the pig farmer in this connection has been the infra-red lamp, which not only serves as a heat source but also attracts the piglets to the nest by its light. Piglets appear to like the warmth on their backs, and will immediately feel heat applied in this way and quickly learn to use it. Warmed floors have never caught on, for though the running costs are less and the danger of power failure is virtually removed, they seem less acceptable or attractive to the piglets. When electric power is not available, heat can be obtained from bottled gas or oil, but these are rarely used. The fire risk is very real with all forms of artificial heat, and heaters must be fixed firmly and safely away from the sow.

The detailed design of the nest is important. The back and the sides should be solid, and a lid is needed in most farrowing houses to prevent down-draught on the piglets from a cold and lofty ceiling. Indeed, if the nest is carefully enclosed in this way, one or two 60-watt light bulbs will be sufficient to provide light and warmth, with consequent saving in equipment and running costs. In the absence of any artificial heat it is perfectly feasible to make a warm nest for the piglets on the same principle as the haybox brooder for chicks, with solid back, sides and top in wood, well covered with straw to conserve the piglets' own heat. Unfortunately there is no real substitute for the artificial light. Nests of this type can be incorporated in all the popular forms of farrowing pen. The crate-type pen usually has nests on both sides of the sow, and in the circular "Ruakura" ring of New Zealand design the nest is in the centre. In pens using farrowing rails, the nest is best fitted along the wall adjoining the service passage, to allow the attendant good access to the piglets. A nest should be about 4 feet long by 2½ feet deep, and the creep space between the bottom rail or board in front and the floor should be 10 inches.

Ventilation and draught

I have placed great emphasis on the use of a solid-walled creep. Now this is important not only to keep the temperature at the correct level, but also to prevent draughts. Piglets are as susceptible to draughts as to low temperatures, and air movement in the nest must be kept to a minimum. This is fairly easy in a totally enclosed indoor farrowing unit, but it can be a major problem in a farrowing house with an outside yard. The greatest care must be taken to site the nest away from the direct line of draught from the doorway between yard and pen, and careful baffling of this doorway is also necessary. A step up between yard and pen will further help to reduce floor draughts, which are particularly common. Yards should never be on the north or east sides of farrowing pens, but preferably on the south aspect.

Farrowing pens can usually be ventilated quite easily and simply. The total air requirements of a sow and litter are modest, and a large volume of airflow in relation to the air space of the building is not required. This means there should be far less possibility of draughts. Usually it is sufficient to

have hopper windows, opening near the eaves, as air inlets, and a simple, controlled ridge or ceiling outlet of the common "chimney" type with a flat cap on top. All ventilators should be fitted with controls. If fans are installed, allow a maximum capacity of 30 cubic feet a minute for each sow and litter; about one-fifth of this will be needed in the coldest weather.

Humidity and dampness

Of course, the piglet does not react to temperature alone, but to the combined effects of temperature, air movement and humidity. The closer any two of these can be to the ideal, the more latitude may be allowed in the third.

As soon as a piglet is born, its body and skin temperatures drop. In a cold environment, this may be fatal. With warmth and a complete absence of draught the fall is far less, and normal body temperature can be regained fairly quickly. But in a humid atmosphere, with damp floor and walls, results can be consistently bad even with ideal air temperatures and no draughts. Conversely, piglets may thrive even in low air temperatures if their bedding is dry and a non-conductor of heat, and there is the least possible movement of air round them.

In short, our humidity requirements are that the floor must be bone dry, the walls free from condensation, and drainage such that urine does not run back into the nest. A good covering of litter such as shavings or short straw is ideal on the floor. To keep the atmosphere of a farrowing house reasonably dry involves holding the relative humidity just under 80 per cent; above this figure it is very difficult to prevent condensation.

Avoiding disease

One of the big problems of indoor farrowing accommodation is how to prevent virulent diseases from sweeping through the building and for a time bringing operations almost to a standstill. I think most specialist pig farmers have had this happen from time to time, and it is well to remember the risk when planning or managing a farrowing house. This problem is in fact common to the "maternity" and "nursing" quarters of most livestock, certainly calves and chicks in addition to pigs. It is noticeable that there is usually less disease in a smaller unit, and far less trouble in quarters where care is taken between farrowings to arrange thorough disinfection and periodic resting of the house or section of the house. All these points should be very much in mind when selecting the design.

I would limit the size of a farrowing house to 4–6 pens, or divide a larger house into separate units of a similar size. These units should be planned so that houses or sections can be vacated for a month to six weeks, annually or biannually. It is an advantage to allow for some outdoor farrowing, if possible, during the summer months, to rest all indoor quarters. The surfaces of the floor and walls in the farrowing quarters should have a finish that can be thoroughly cleaned and disinfected between farrowings, so that they are cleared of the so-called disease "build-up"—that rather nebulous scourge of intensive animal buildings. In passing, it is worth mentioning that with small units it will be much easier to keep the piglets warm and comfortable.

Practical details of construction

A great deal of attention has been given recently to the detailed design of farrowing pens. We have not reached the stage where design can replace good stockmanship, but it can aid and encourage it. In the right hands, most designs can give good results, whereas if the enthusiasm of the stockman is lacking, troubles can be experienced in the most perfect set-up. For this reason, I would advise any farmer to build his pen in close collaboration with his pigman, and make sure he is happy with the lay-out.

The best results come consistently from built-in farrowing crates or rings, of which there are several excellent designs. My choice, therefore, would be to have farrowing accommodation separate from rearing pens; I think the needs of very young piglets warrant this special care. But obviously, much must depend on the size of the enterprise. The sow would have three or four days in the crate before farrowing, and a week to ten days after farrowing she would be moved to the rearing pen.

In construction, the farrowing house itself should be well insulated, and the size and height no more than gives the stockman room to move. Therefore, with careful planning, the cost can be kept to reasonable proportions. The floor should be of good, concrete construction, and—this is most important—there should be a damp-proof course in the floor, beneath a fairly simple insulation layer of light-weight aggregate concrete with a thin cement screed on top. Walls and roof should also be insulated to a high standard, with all insulation layers of the building covered on the inside with recognized vapour seals, such as polythene sheets or kraft paper; it is extraordinary how little attention *is* given to the importance of keeping insulation dry, when it is well known that wet heat insulation is of little value. The crate, nests and other fittings, if of wood—which is particularly attractive to the farmer-builder owing to its cheapness and ease of working—should be made portable, so that everything can be dismantled for cleaning and disinfection.

In a survey I carried out a few years ago, I found that with good indoor farrowing accommodation losses were steady at from seven to ten per cent throughout the year, whereas in poor indoor or outdoor accommodation there was a pronounced seasonal rise in losses, the peak being reached in late winter, when up to 50 per cent of the piglets born alive were being lost before weaning. Nevertheless, though good indoor farrowing offers the best results, the dangers of disease are far greater than with outdoor farrowing on clean pasture. It should only be attempted if the environment, design of pens and management are satisfactory, and the standard of hygiene is impeccable.

Control of Greening in Undrawn Hens

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Feeding antibiotics in the forty-eight hours immediately before slaughter may prove to be a practical alternative to refrigeration for the control of greening—and one requiring less capital.

WITH the introduction of the broiler, relatively cheap poultry meat is now available throughout the year. Consequently, it is becoming increasingly difficult to market hens at the end of their laying season as table poultry, and greater emphasis is being placed on their quality.

One reason for the success of the broiler industry has been the widespread use of refrigeration during packing, wholesaling and retailing, which has made possible the mass production and distribution of oven-ready birds. Hens, on the other hand, are seldom handled in this way, and are more commonly marketed undrawn in relatively small numbers. In this traditional form they are less perishable than the eviscerated carcasses, and are spoilt chiefly by the development of green patches on the skin, at first around the vent and on the abdomen, and later over the ribs and along the back. Carcasses spoilt in this way are often described as "greenstruck".

Greening is a result of the biochemical activities of the bacteria which are naturally present in the intestines, particularly the caeca, and which continue to multiply after the death of the bird. One of the products of this bacterial metabolism is the gas, hydrogen sulphide, which diffuses through the intestinal wall into the muscle tissue. There, in the presence of air, it combines with the haem pigments of blood and muscle to form the green pigment sulphaemoglobin. There is a possibility that another green pigment, choleglobin, is also present, since this can be formed under similar conditions and closely resembles sulphaemoglobin spectroscopically. However, this transformation of the pigments of blood and muscle is never complete, and the discoloured tissues always contain some unchanged pigments.

Greening around the vent is usually caused by intestinal contents which have been left in the rectum, and which can easily be expressed after plucking by finger-pressure on the abdomen. More generally, however, greening first develops as a patch on one side of the abdomen, usually the left, and this cannot be prevented by external manipulation. Dissection of a carcass shows that the blind tips of the caeca are nearest to the body wall at this point. Hence, the hydrogen sulphide produced by the caecal bacteria can readily diffuse into this region of adjacent abdominal muscle and cause a green patch. It should be noted, however, that whilst the same pigment (from spectroscopic analysis) is present on all greened areas of the skin and muscle, greening of the liver, which in any case cannot be seen until a carcass is opened, is caused by the bile.

From a review[1] of early American work[2, 3] and of more recent experimental work in the Low Temperature Research Station,[4] it is clear that

greening is most effectively delayed by refrigeration; but the capital outlay is considerable, and for the marketing of hens this may not always be immediately practicable. Promise of a new method of control, which could be applied immediately because it could be effective even without refrigeration, was given by the results of experiments on pre-slaughter treatments of poultry.[5] The object of these treatments was to suppress the gas-producing activities of the intestinal bacteria by administering commercial antibiotics before the birds were slaughtered. With the most successful treatment, storage at 59°F was extended by 30 per cent (one day) in prime condition and by 82 per cent (six days), before the areas over the ribs or back greened.

In these experiments, the antibiotic was given in the drinking water during the traditional 24-hour period of starvation before slaughter; but it is also possible to mix it in a specially-modified feed which is given for the 48 hours preceding slaughter with no period of starvation and consequent loss of live weight.

This alternative method of administration in the feed is based on unpublished results of recent experiments at the Low Temperature Research Station, from which it was concluded that the caecal production of hydrogen sulphide was dependent upon the activity of the bacterial enzyme cysteine desulphydrase. This enzyme, which is most active at the usual pH of expressed caecal contents—between 6·0 and 7·0—is almost inactive when the pH is less than 5·0. Such a low pH can be produced in caecal contents after the death of the bird by establishing an acid fermentation, and this has been achieved in practice by adding lactose, as dried skim milk, to the standard feed of the bird for 48 hours preceding slaughter. When a commercial antibiotic is also included in this modified feed, the rapid multiplication of the caecal flora and the associated rise in pH after the death of the bird are still further delayed.

The pre-slaughter administration of both treated drinking water and feed have been tested under commercial conditions in the field. Orkney was chosen for these trials for three reasons. Greening was causing severe losses to the trade in the hot summer of 1959; the islands must export large numbers of hens annually as table birds because, amongst the Scottish counties, Orkney is second only to Aberdeenshire in egg production; and marketing conditions are rather difficult because all produce must make a long sea journey to reach even the larger Scottish markets.

Experimental conditions

The field trials were made in July and September of 1959, and on each occasion a complete consignment of poultry from Kirkwall was used. The weather conditions were similar on both occasions and the midday temperatures were relatively high—about 66°F in Kirkwall and 77°F in Aberdeen.

The birds, which were all culled hens, were obtained from nine farms, one being large enough to provide both control and treated groups. The treatments were distributed at random amongst the other farms. After collection from the farms all the birds were handled under nearly identical conditions; they were killed, plucked, cooled and boxed in one packing station, and shipped together and handled by one wholesaler in Aberdeen, although a different one for the July and September shipments.

Pre-slaughter treatments began on the morning of Sunday or Monday as appropriate. On Tuesday morning the birds were crated and taken by road (for not more than one hour) to the poultry packing station in Kirkwall where, by the end of the day, all had been killed, slack scalded, plucked and hung on racks to cool overnight at room temperature. The treated birds were processed first, and a check was also made that the vents had been pressed to expel free rectal contents and so minimize greening around the vent. On the Wednesday morning the carcasses were packed in single layers in cardboard boxes and taken by road to Stromness (about one hour) for shipping. The boxed poultry was unloaded at Aberdeen between 9 a.m. and 10 a.m. on the following morning and taken immediately to the wholesalers, where grading was completed by 1 p.m. The carcasses were then placed in a chill room at 32–36°F. All the carcasses were thus held for about 40–48 hours without refrigeration between slaughter and marketing.

Three treatments compared

Three treatments were used: A, a supplement in the feed; B, a supplement in the drinking water; and C, control, with no special treatment.

The composition of the special feed used in treatment A is shown in Table 1, and the experimental procedures are summarized in Table 2.

Table 1

Composition of special feed used in treatment A and fed for the 48 hours preceding slaughter

Layers' mash	3 parts by weight
Dried skim milk*	1 part by weight
Feed grade antibiotic†	100 parts per million (5g per cwt)

* A low grade obtained as a by-product from a milk factory and powdered on a farm "bruiser".

† Chlortetracycline (Aureomycin) as Aurofac-2A or oxytetracycline (Terramycin) as Terramycin feed supplement TM5.

Table 2

Experimental procedures

Treatment	Duration *hr.*	Supplement to Feed	Supplement to Water	Period of starvation (*hr.*)
A	48	Layers' mash replaced with special feed	None	None
B	24	None	A commercial formulation of an antibiotic at 100 p.p.m.	24
C	Control—no special treatment			24

In treatment B, soluble preparations of chlortetracycline or oxytetracycline were added to the drinking water to give a concentration of 100 p.p.m. of antibiotic (approximately ½ oz in 30 gal). The ideal concentration of tetracycline antibiotic in either feed or water is not known; the results of laboratory experiments have suggested that whilst 100 p.p.m. may be more effective than 50 p.p.m., there is probably little advantage in increasing the concentration still further.

In treatment C the birds were starved for the traditional period of 24 hours and no additives were given. This was considered to be the most suitable control treatment because it is a procedure generally recommended in the industry; furthermore it has been demonstrated experimentally that greening is thus delayed by 20 per cent compared with birds which have been fed on mash until they are slaughtered.[5]

Results of the treatments

The results of both the July and the September trials are summarized in Table 3 on p. 24.

The most effective was treatment A; both antibiotics were equally effective for practical purposes, and each reduced the incidence of greening by up to four times. The effectiveness and consistency of these results are in keeping with previous laboratory experience, where it has also been found that of the antibiotics at present available commercially, chlortetracycline and oxytetracycline are the most likely to control greening successfully.

In the July trials, the two treatments A and C were carried out on one farm. Those hens which received treatment A had an average live weight at slaughter of 6·3 lb, compared with 5·7 lb for their sisters which had been starved in the traditional way before slaughter. This gain is more than sufficient to offset the cost of the treatment.

An approximate costing of the experimental treatments is given in Table 4. It is based on the market prices current in the north-east of Scotland during the first fortnight of September, but no account has been taken of the cost of labour because of the difficulty of estimating this on "family farms".

Choice depends on local conditions

Which of the treatments A or B is used in any particular case will depend very largely upon local conditions, but when a choice is possible treatment A (special feed for the two days preceding slaughter) is the better one. Not only is there a greater profit, but the administration of the antibiotic is more certain. For example, it has been a laboratory experience that the birds may not always drink sufficient to obtain an adequate dose of the antibiotic in water.[5] However, when oxytetracycline is to be added to the drinking water, the veterinary preparation called "Terramycin animal powder soluble formula" is probably more suitable than Biostat, but unfortunately there was no opportunity of testing the first formulation in September.

Aurofac-2A, Terramycin feed supplement TM5 and several grades of dried skim milk are readily available, and may be purchased directly by either the farmer or the miller for incorporation in the feed, at the concentrations recommended here. "Aureomycin soluble tinted" and "Terramycin animal powder soluble formula", however, are only obtainable with a veterinary prescription.

It must be emphasized that the full benefit from the reduction of "greening" will not be obtained unless the conformation and finish of the table birds entitle them to be placed in the top grade. There is little point in preventing "greening" if the carcasses are going to be down-graded in any case because of crooked breasts and poor finish. In the September trial, for

Table 3

Summarized results of the July and September trials

Treatment	PRE-SLAUGHTER TREATMENT IN ORKNEY				GRADING OF CARCASSES IN ABERDEEN
	Number of hens	Date	Antibiotic	Commercial preparation	Per cent sufficiently greened for down-grading
A	96	July	Oxytetracycline	Biostat	5·2
	48	September	„	Terramycin feed supplement TM5	6·3
	66	September	Chlortetracycline	Aurofac-2A	4·6
B	105	July	Oxytetracycline	Biostat*	9·5
	40	September	Chlortetracycline	Aureomycin soluble tinted	5·0
C	151	July	—	—	21·8
	28	September	—	—	21·4

* It is possible that the veterinary formulation "Terramycin animal powder soluble formula" would be more satisfactory but there was no opportunity to test this in September.

Table 4

Approximate cost per bird, allowing 4 oz of feed per bird and 1 gallon of water for 20 birds, and based on market prices current in the north-east of Scotland during the first fortnight of September 1959

Treatment	Cost of feed and supplements for 2 days preceding slaughter	Extra cost of experimental treatments	Gain per bird from experimental treatments		
			From improved grading*	From increased live weight	Net gain per bird
	d.	*d.*	*d.*	*d.*	*d.*
A†	2½	1½	2½	6	6½
B†	1½	1	2½	—	1½
C	½	—	—	—	—

* Assuming payment is based on the packers' grading of the plucked birds, and allowing a difference of 3*d.* per lb live weight between 1st and 2nd grades.

† Costing is similar for preparations of either chlortetracycline or oxytetracycline.

example, 64 per cent of the "greened" carcasses were also down-graded for these reasons. Possibly an extension to the farmer of the system of payment based on carcass grading as well as weight would provide an additional incentive to market carcasses of good quality.

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Strawberries and Soil-borne Virus Diseases

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Mr. Lister summarizes what is known of the prevalence, effects and importance of the soil-borne virus diseases, so that growers can be on their guard against confusing them with other kinds of disease.

STRAWBERRY growers have long known the aphid-borne viruses causing the yellow-edge and crinkle diseases, and since the 1930s it has been realized that these were major causes of degeneration in strawberry crops. During the last ten years, stocks free from these viruses have been produced at East Malling and made available through the Nuclear Stock Association, and progressive growers have not been slow to make use of them. The resulting improvement in the general quality and vigour of stocks throughout the country has been very impressive. Indeed, some people anticipated that the general availability of virus-free stocks and the widespread use of effective insecticides had, for practical purposes, solved the problem of virus diseases in strawberry.

Unfortunately, such hopes are often short-lived where the growing of

plants is concerned, and recent work has shown that other diseases, which are caused by viruses harboured in and transmitted through the soil, are of considerable importance in strawberry crops in many places in Britain.

So far, three soil-borne viruses are known to affect strawberry; they are called arabis mosaic, raspberry ringspot and tomato black ring. All three infect a very wide range of hosts, including not only crop plants, but also many common weeds. For example, as well as strawberry, all three viruses affect raspberry, French bean, lettuce, cucumber and sugar beet; and tomato black ring, at least, causes disease in oats and potatoes. Common weeds which are susceptible include groundsel, shepherd's purse, chickweed and many others. Clearly there is little hope of being able to get rid of the viruses from soils simply by crop rotation, for they can be maintained in so many species of plant. Thus, so far as is known, soils which are infective are likely to remain so indefinitely.

Though some other viruses seem to be held in the soil by absorption, and released directly to plant roots, it is certain that all three of these viruses are transmitted by microscopic soil-living organisms. In fact, it has been shown recently that arabis mosaic is transmitted by eelworms of the genus *Xiphinema*. This is a genus of the so-called "dagger nematodes", armed with a sharp stylet, with which they pierce the root cells of the wide variety of plants they feed on. No vectors are yet known for raspberry ringspot and tomato black ring, but it seems likely that they will also prove to be transmitted by eelworms.

Distribution and symptoms

Some outbreaks of soil-borne virus diseases in strawberry are the result of planting infected stocks: others are indigenous; that is, due to the presence of virus in the soil. Indigenous outbreaks of soil-borne virus diseases have been found in strawberry in the following counties of Britain:

ENGLAND	SCOTLAND
Cheshire	Angus
Cornwall	Lanarkshire
Devon	Midlothian
Hampshire	Morayshire
Herefordshire	Perthshire
Kent	Sutherland
Norfolk	
Warwickshire	WALES
Wiltshire	Pembrokeshire

Rather curiously, all the outbreaks found so far in strawberry crops in England have turned out to be of arabis mosaic virus, whereas the great majority of those from Scotland have been of raspberry ringspot and tomato black ring. But viruses do not respect man-made frontiers and, in fact, all three are known, from their occurrence in other crops, to be indigenous in England too, and probably also in other parts of Europe.

The following table, which is derived from records of the viruses isolated from plants collected in field outbreaks, shows that all the important commercial varieties of strawberry grown in Britain are susceptible to one or more of the soil-borne viruses.

Photo: *Scottish Horticultural Research Institute*

Strawberries and Soil-borne Virus Diseases. Maiden Cambridge Favourite strawberries. The plant on the left is infected with arabis mosaic virus. (*Inset:* leaf symptoms of tomato black ring virus on Talisman.)

Photo: *Scottish Horticultural Research Institute*

Strawberries and Soil-borne Virus Diseases. An outbreak of raspberry ringspot virus developing in Talisman.

Indoor Farrowing (Article on pp. 16–19)

Photo: *Eric Harris*
Reproduced by kind permission of "Farm and Country"

An infra-red lamp not only serves as a source of heat, but also attracts piglets to the creep by its light.

Inside a well-insulated, mechanically ventilated indoor farrowing house. Smooth concrete and metal finish make for easier cleaning and good hygiene.

Simple Sheep Handling (Article on pp. 29–30)

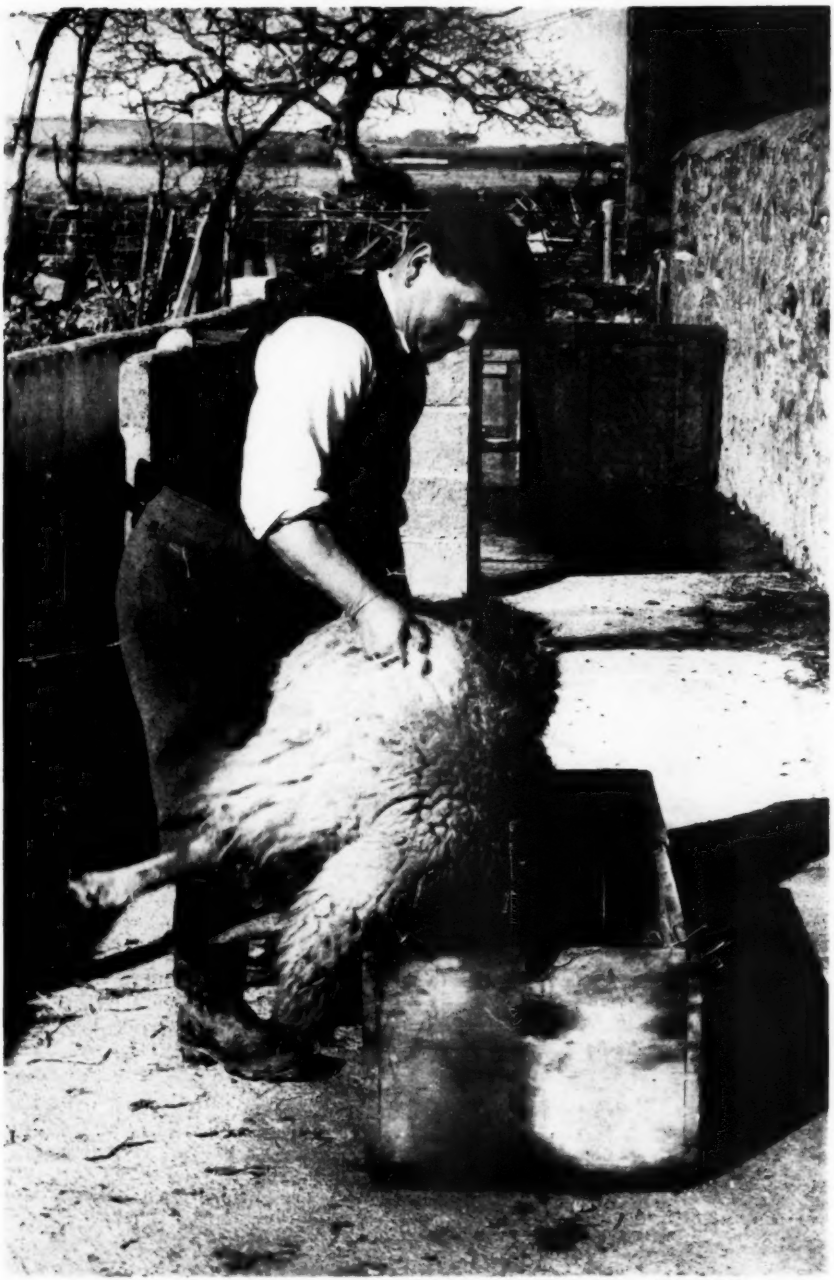

Photo: *John L. Jones*

For such routine tasks as treating a sheep for foot rot, what could be simpler than this?

Susceptibility of strawberry varieties to soil-borne virus infection

VARIETY	Raspberry ringspot	Tomato black ring	Arabis mosaic
Deutsch Evern			+
Early Cambridge		+	+
Favourite	+		+
General McMahon		+	
Huxley	+		
Madame Lefebvre	+		+
Merton Princess	+	+	+
Prizewinner			+
Rearguard	+	+	+
Redgauntlet		+	+
Royal Sovereign	+	+	+
Senga 54		+	
Surprise		+	
Talisman	+	+	+
Vigour	+		+

The range of symptoms shown is very wide, and at present it is not possible to list the reactions of each variety to infection with each virus. Generally speaking, plants infected with arabis mosaic are dwarfed, often severely, and their leaves are twisted and distorted and blotched with yellow. Infection with raspberry ringspot or tomato black ring, two viruses which often occur together in soils, also results in the dwarfing of plants, and the development of a variety of yellow spots, rings and streaks on the leaves. The symptoms of all the viruses are most striking in late spring, before fruit is set, and again when quick growth is taking place in the early autumn. In some varieties, particularly with recent infections, symptoms tend to disappear in the summer, and the infections are masked by the development of normal-looking growth. Nevertheless, the degeneration of infected plants is always progressive, and after a year or two they become useless.

An important point about the symptoms caused by the soil-borne viruses is the possibility of confusing them with other effects often seen in strawberry, such as damage due to leaf- and bud-feeding eelworms and shallot aphids; the kind of leaf-yellowing caused by mineral deficiencies or excess lime; and, of course, the aphid-borne virus diseases, particularly crinkle. Because of this, a good deal of infection may pass unnoticed, or be assigned to other causes. Certainly in the past, before virus-free stocks of the important strawberry varieties became so widely grown, the effects of aphid-borne virus diseases probably obscured those of soil-borne viruses. Certain general characteristics of outbreaks do help in diagnosis: for example, indigenous outbreaks in fruiting plantations usually consist of more or less circular patches of dwarfed plants. When this occurs, and red core and *Verticillium* wilt are ruled out, soil-borne virus symptoms should be looked for. Where outbreaks are not indigenous, but due to the planting of an infected stock, degeneration is usually much more rapid, and the scattered, dwarfed plants stand out in comparison with their more vigorous neighbours.

Difficulties in certification

Strawberry varieties differ in the rate at which they become infected and show symptoms when grown in infective soil. Some seem to develop marked

symptoms within a few months of planting, while in others the viruses remain in the roots for some time, and it may be a year or more before leaf symptoms are seen. This can cause great difficulties in the certification of strawberries propagated for sale. Cases are known where certified stocks, sold in perfectly good faith by growers who have taken the greatest precautions against the spread of aphid-borne viruses, have rapidly degenerated when planted by the buyer.

To prevent this in the future, special attention is now being paid in inspections to the possible presence of soil-borne viruses. In Scotland, the certification scheme has been modified in respect of them, and no stocks are now certified in which any soil-borne virus infections are diagnosed visually and by laboratory tests; for one proven infection may indicate the presence of many. In England, too, the use of laboratory tests is being developed, and a close watch is being kept on the occurrence of infections in runner beds.

The problem is the greater because not only does the buyer of an infected stock stand to suffer a direct loss, but there is a risk that his land may become infective through the growing of infected plants. However, this can probably only occur in certain kinds of soil; that is, in those in which the necessary vector species is already present or can establish itself. The viruses can be introduced into such soils not only by the strawberry, but probably also by growing any infected stocks of vegetatively propagated plants, including potato and raspberry. They could also be disseminated in the infected seeds of some of their hosts, including weeds, for when infected seeds are dispersed, and germinate in new soils, they will supply virus which can be transmitted to adjacent crop plants, if the necessary vectors are present. The finding that these viruses are transmitted through seeds is so recent that it is not yet known how important a mode of spread it is.

Control measures

From what has been said above, it will be clear that the diagnosis of infections in runner beds is an essential first step in the control of soil-borne viruses. Any grower unfortunate enough to have acquired an infected stock would be wise to pull out and destroy all infected plants, if not the entire stock, as soon as possible. For indigenous outbreaks, direct chemical control measures may eventually be developed to eliminate the vectors of the virus, particularly when more is known about them. As the viruses may be maintained in weeds, and spread in weed seeds, efficient weed control will also be valuable.

It may be possible in the future to find immune strawberry varieties, for though none are known at present, there are signs that resistance may exist. (Immune varieties of raspberry are already known.) However, it already seems possible to take at least one good crop of berries from maidens of some varieties before degeneration becomes serious, so that especially in areas where early planting is possible, growing a stock for one year only would get over the problem to some extent. Naturally, any runners produced in an indigenous outbreak, even from healthy-looking plants, would be useless.

Though soil-borne virus diseases are definitely a serious problem in the growing of strawberries in some areas, we must be careful not to exaggerate

their importance. Almost certainly they are not new, for such adaptable and efficiently-spread diseases have no doubt been propagated in wild as well as crop plants for a long time. Clearly they are not especially diseases of strawberry, or even of cultivated crops in general, but probably survive naturally in a variety of wild plants. Thus the fact that a particular piece of land has never carried a crop of any kind is no guarantee that soil-borne viruses will not be present. Even though the characteristic symptoms in strawberry are now well known among advisory officers and inspectors, it will be some time before we have a complete picture of the extent of soil-borne virus infections. So far as we know at present they are not of outstanding general importance in fruiting plantations, though in certain localities they are serious enough. But in the propagation of strawberry runner plants for certification and sale they present a problem similar in kind and importance to that of red core disease.

Simple Sheep Handling

JOHN L. JONES

PERHAPS because man was a shepherd before he became a farmer, sheep husbandry seems to command a pride and application that are surely unique. This is not to imply that other farm livestock do not figure prominently and call out creative endeavour. It is just that some lingering ancestral feeling for flocks seems to invest the individual crafts and solutions of sheep problems with unusual conviction.

In particular the designs of sheep handling equipment are frequently a source of personal pride. It is true that Britain is now borrowing widely from the experience of New Zealand, where very few men and multitudes of sheep have inspired the design of many labour-saving handling devices and the Wool Board has been assiduous in fostering contacts. But within a framework of increasing standardization on New Zealand patterns there are still many highly individual solutions worthy of study, often tailor-made to the farm, that work impressively well.

Mr. Arthur Prichard, of Escalwen Farm near Letterston in Pembrokeshire, believes firmly in simplicity; and this is certainly the heart of his sheep handling set-up, which he aims to make as familiar to his sheep as the milking bail is to his cows. At peak stocking his flock numbers 850 ewes and lambs. Yet except for such communal matters as shearing and washing, the flock husbandry, thanks to efficient handling, is the part-time work of one man.

The west side of his pens consists of the wall of the cattle collecting yards into which the ewes are brought from the fields. At the opening of the gate the sheep move forward into the first pen, and make for the two-feet-wide race which is used for virtually all husbandry tasks. Animals, says Mr. Prichard, move voluntarily for two principal reasons; food and the lure of

freedom. With frequent movement through the handling pens, the flock learns rapidly that forward is the road to freedom. At no stage does one sheep lose sight of another, and mostly they can see straight through from one end of the pens to the release gate into the paddocks. The pens run slightly uphill. At the end of the race as they reach the shedding doors, the sheep are shed either forward into a holding pen and subsequently into a paddock, or sideways into a second holding paddock, or of course back through again.

Exploiting a race

The race is in fact the operational centre of the flock: as a foot-bath, as the entrance to the dip, as a shedding place for market-ready lambs, for easy catching for castration and docking, injection and drenching. The entrance to the dip is usually shut off with a door, but this is replaced at dipping time with a curtain which conceals a shiny sloping steel plate that skids the sheep feet first and sideways into the dip.

Mr. Prichard has his own particular labour-saving methods for shearing, which again exploit the race and the flock's familiarity with the handling set-up. The shearing is done on the floor of the draining pen, and sheep awaiting shearing are penned in the race. To avoid having to manhandle them to the shearer, his assistant loops a length of cord—exactly equal to the distance between the race and the shearer—over the door-post of the race exit door. The second loop is put over the head of the sheep at the front of the queue, the door is opened and the sheep runs forward towards the shearer where, pulled up sharply by the cord, it is caught without fuss.

Like most flockmasters with a fair share of intuition, Mr. Prichard has his own prescription for adoption. (The pet lamb is a pleasant image but in practice a nuisance.) To foist a lamb on to a strange ewe, newly lambed with a single but having enough milk for two, the fosterling and the natural lamb are kept together in a bin for two or three days. They are then brought out for periodic supervised suckling until mixed smells induce acceptance from the confused ewe. Mr. Prichard believes that the frame of mind of the ewe is the important thing in securing easy adoption. If, for example, he finds a newly-lambed ewe in the field with a dead lamb, he attaches a piece of cord to the lamb and pulls it home. The ewe follows it to the steading with the impression that it is still alive, and is thus in the ideal emotional state for adopting. The dead lamb is quickly skinned and the skin put on the fosterling.

For certain routine tasks such as treating foot rot, Mr. Prichard does not consider it necessary to buy special equipment. The perfect position for treating a sheep's feet is that of the cast ewe with her legs helplessly in the air. So for this task he uses a hay-padded box roughly the length of the sheep, tips her over in it and thus has both hands free for the work.

Winter Cauliflower in Brittany

D. J. FULLER, B.Sc., N.D.H.
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Mr. Fuller has been taking another look at the winter cauliflower industry in Brittany. His article will have a special interest for Cornish growers, although circumstances are not identical on both sides of the Channel.

SOME thirty years ago winter cauliflower growing in west Cornwall was revolutionized by the introduction of new strains of seed from the Roscoff area of Brittany, and it was these strains which founded the present-day Cornish industry. During this time the industry has gradually changed, and it may be interesting, therefore, to look at current production methods in Brittany, where the acreage is four to five times that in Cornwall.

Since the eighteenth century, vegetable growing has been important in the area immediately around St. Pol-de-Léon and Roscoff, and since the mid nineteenth century the export of produce to Great Britain has played an important part in the development of the region. The phenomenal growth of the winter cauliflower growing industry is seen in the following figures:

year	*acres*	*year*	*acres*
1892	2,320	1953	19,025
1911	2,965	1954	19,770
1939	6,780	1955	22,240

This increase has been accompanied by a corresponding rise in the acreage of other vegetables, and the area of intensive production has gradually spread outwards from St. Pol-de-Léon into the surrounding countryside until now it covers a region some 30 miles long and 12 miles wide.

Climate and soil

The climate of the region is regulated by its proximity to the sea, and does not show the extreme temperatures typical of many other parts of the Continent. Average temperatures are approximately equal to those of west Cornwall, with the same relative freedom from frost in the coastal areas. The freedom from frost decreases inland from the sea or the numerous estuaries, and this factor, coupled with suitable soil, has set the natural limits to the area in which winter cauliflower can be grown successfully.

Much of the region is exposed to winds from the sea, but the trees indicate that wind damage is less severe than in many parts of Cornwall. The average rainfall is relatively low, and this is of obvious importance in connection with the home saving of winter cauliflower seed.

The region is essentially a plateau formed by erosion at the edge of the granite mass of the Brittany peninsula. Formed from the decomposition of the granite, the soils extend to a depth of 15–18 feet immediately around

St. Pol-de-Léon and, given suitable treatment to correct a low pH, they are very fertile. Following years of intensive cultivation, they now have a high organic nitrogen content but the potash tends to be low.

Land values are high throughout the area, but closeness to the sea and the suitability of the soil are the over-riding factors. Present-day prices range from £160 to £800 per acre, according to quality.

Very small farms

Small family holdings predominate, and in the original intensive districts sub-division of the land between members of the family has occurred so frequently that further division is economically impossible. A typical example is the *canton* of Plouénan, in which 120 farms are of more than 25 acres, 120 between 12½ and 25 acres, and 193 less than 12½ acres.

The importance of vegetable crops in the rotation varies with the location, and whereas general farm crops form a considerable part of the rotation on the larger farms in the outlying districts, the smaller farms in the centre are used almost exclusively for market-garden crops. Winter cauliflower, globe artichokes and early potatoes are the main crops, and the region immediately around Roscoff is of course famous for its onions. Approximately half of France's seed potatoes are produced in Finistère, the important areas being between Pleyber-Christ and Mespaul and to the east of Morlaix Bay.

The first winter cauliflower from this area is cut in late November, but the bulk of the crop is marketed from mid February to the end of May. By continuous selection through the years, the season has gradually been extended until some growers now have strains which can be cut as late as mid June.

The seedbeds are usually in small sheltered enclosures close to the farmhouse. Seed sowing starts in late March for the earliest varieties, but even the latest are sown by mid April. Much of the seed is still broadcast in narrow beds, but a number of growers are considering the advantages of sowing in rows to facilitate weeding in the early stages.

Approximately one month after seed sowing the plants are large enough to handle, and they are then pricked out. Some growers use a spacing of 10×10 inches for this pricking out, but the majority put them closer than this in the row, and a spacing of $10–12 \times 4–6$ inches is normal. Due to the staggering of the seed sowing dates, the plants are pricked out in successive batches over approximately one month, and at this stage great care is taken to discard any poorly developed plants.

Once pricked out, the seedlings have room to grow and develop into sturdy, short-jointed plants which more nearly resemble pot-grown cauliflower plants than the type of winter cauliflower in general use in Britain.

Manuring

Farmyard manure at the rate of 12–14 tons an acre is a normal predressing, and although this may not seem particularly high, it must be remembered that livestock are kept on all the farms and that similar dressings are given at frequent intervals during the course of the rotation.

The farmyard manure is often supplemented by dressings of up to 4 tons

per acre of dried seaweed. Seaweed collection is carefully regulated by local laws, and the weed gathered from the rocks with special boats during low tides is considered superior to that washed up during storms; the latter often contains a high proportion of the less desirable species. Stacked in heaps, the seaweed is protected from rain by large flat stones and, when dry, is often sold to inland farmers, although this trade is limited by the cost of transport.

Sea sand (*trez*), containing 45–52 per cent $CaCO_3$, is used to adjust the pH of the soil. A type of magnesian lime (*maerl*), containing 78–82 per cent $CaCO_3$ and 8–10 per cent $MgCO_3$, is also used.

Fertilizer is applied before planting, and the present official recommendation is 4–5 cwt sulphate of ammonia, 5–6 cwt superphosphate (16 per cent) or 6–8 cwt basic slag and 1½–2 cwt sulphate of potash per acre, but some growers tend to give rather more nitrogen and less potash than this. It is considered that nitrogenous fertilizers are essential to give the large heads, but excess nitrogen has a tendency to cause yellowing of the curd.

The question of top dressings for the crop is controversial, but some growers are in favour of a dressing of 3–4 cwt per acre of a complete fertilizer (6:10:10) during late September or October for the early and midseason varieties. Nitro-Chalk at the rate of 3 cwt per acre is commonly given to the late varieties during January or February. Trials are being carried out to ascertain the effects of fertilizer placement, as opposed to broadcast top dressings.

Planting

Planting out of the very earliest varieties begins in the second week of July but, due to the pricking out, the plants can be held longer than normal and need not be transferred to their final positions until later in the season. The bulk of the planting is completed by mid August but some of the latest varieties, which follow corn crops, are not transplanted until early September. All poorly developed plants are discarded, and the remainder are put out at a spacing of 3 feet 3 inches square.

The plants have a much larger ball of fibrous roots than is usual in this country and, because of this, virtually all the planting is done by hand with a special tool resembling the dibbler used in east Cornwall and south Devon. A few growers have been trying out planting machines during recent years, but obviously any machine with a complicated system of fingers to handle the plants would result in a high proportion of broken stems. The machines in use consist of a simple share to open up a groove for the plants and two metal plates to press the soil back around them. After planting, the soil is cultivated to control weeds and the plants are banked up in autumn to improve drainage and prevent wind damage.

Seed production

At first, definite varieties such as Giant of Naples, Algiers Giant and Autumn Giant were grown, but these have been gradually eliminated by continuous selection over the years.

Stocks of seeds are jealously guarded by the growers, and in many cases

they have been handed down in the family for several generations. Each grower maintains four or five selections to cover the cropping season, and each selection is usually in cut for about a month or five weeks. There is a tendency for a relatively high proportion of the earlier types to be grown in the coastal areas because of the comparative ease of overwintering stock plants, but there are no distinct regions devoted to one variety and the complete range is grown throughout the area. On the rare occasions that seed is exchanged between farmers, the price is at least five to six times that in England, and at the pricking-out stage the plants have a value of approximately £1 14*s*. per 1,000.

Plants for seed production are very carefully selected from the market crop. Where the winter cauliflower crop precedes early potatoes, the seed plants are carefully lifted and transferred to the garden, but whenever possible they are left *in situ* and the subsequent crop planted around them. The earlier selections flower in May and June, the semi-lates in June–July and the lates in July–August. Once the seed is ripe, the stems are cut and hung up in a shed until dry, when the seed is threshed out. Under favourable circumstances each head will yield 2 oz of seed, but losses can be heavy in a wet season and most growers leave more than enough plants for their needs because of the difficulties of replacing lost stocks.

The primary factor in selecting a plant for seed production is the type of curd. From six to twelve plants per acre are kept for seed production, usually from the later plants in each batch, since these are considered to give firmer curds than those which mature early. Large heads are invariably selected and they must be of good colour, free from bracting or riciness. A number of the branches of the inflorescence must be almost horizontal to give a deep curd, and the individual segments of the curd must be large, since it is claimed that seed from those with small segments gives a high proportion of small heads.

Leaf characters are of secondary importance to curd characters, but plants which have suffered from leaf drop, or have leaves which do not protect the curd properly, are not selected. There appears to be some controversy over the type of stump to select: some maintain that a large, well-developed stump is an essential character of the best plants, but others hold that a smaller one is less likely to rot once the stems run up to seed.

The growers maintain that any inferior plants left to seed invariably produce more seed per plant than the best selections. They think that this is why no seed merchant has yet found it economic to produce a stock of comparable quality to the traditional Roscoff strains, as the quality quickly deteriorates with any attempt at bulk seed production.

Marketing

Each selection is in cut for several weeks. The work of cutting has been facilitated by the development of special carts with rubber-tyred wheels, which can be drawn through the crop without causing too much damage. Individual growers do not do their own packing, and the crop is sold either through the agricultural co-operatives or to merchants specializing in the export of horticultural crops. The agricultural co-operative system has been extensively developed and is now used by a high proportion of the growers,

not only for marketing but for the purchase of feedingstuffs, fertilizers and sundries.

Whether the crop is sold through the co-operatives or to an independent merchant, the procedure for packing is essentially the same. After grading, the leaves are trimmed over a conveyor belt which takes the waste out through the end of the packing shed. There it is collected by the farmers and used for cattle feed or for composting. The large heads, with the leaves trimmed well back, are used for the Continental markets, and the smaller heads (*moudets*), with more leaf attached, are packed 24 or 30 to a crate for export to England. Two quality grades are distinguished for each size grade, and all the produce is packed in non-returnable containers. In recent years, in order to reduce freight charges, part of the crop has been wrapped in waxed paper after the leaves have been trimmed right back to the base.

All produce is subject to official inspection before loading for export. The inspection system is financed by the exporters by means of a levy on each package. Approximately half the crop is sold in France and the remainder is distributed over all the main European countries, with Great Britain as the greatest single customer and Western Germany taking an increasing proportion of the crop.

The biggest contrasts between the industries in Brittany and in Cornwall are to be seen in farm mechanization and marketing. With present-day labour costs it would be out of the question for Cornish growers to revert to hand labour, but there is little doubt that the French marketing organization has much to commend it in comparison with a system where numerous small growers grade, pack and market their own produce. Selection of seed plants equivalent to mother stock standards has undoubtedly been of some advantage in Brittany, but the new methods of vegetatively propagating stock plants which are now being developed in this country should overcome this in the near future.

Private Consultants in Agriculture and Horticulture

B. S. FURNEAUX, M.Sc., F.G.S.

Chairman, British Association of Consultants in Agriculture and Horticulture

The N.A.A.S. gives farmers everywhere a free advisory service of a high standard, covering most of the important branches of agriculture and horticulture. What, then, is the place of the private consultant?

THERE are many of us still actively concerned with agriculture who remember the light-hearted leg-pulling that the scientist often met when he made his first visit to a particular farm. In a number of cases, between the farmer, whose humour did not completely disguise his scepticism of the application of science to practical husbandry, and his "victim" there subsequently grew up a close friendship that became deeply valued on either side. Few people today would dispute the value of science to the farmer, yet this used still to occur little more than a couple of decades ago.

The change has been the work of many people and organizations. The universities, research stations, the county councils, agricultural executive committees and the Ministry of Agriculture, to say nothing of the agricultural and horticultural press, have all made their contributions. When the National Agricultural Advisory Service was brought into being in 1946, it already had a solid foundation to build on. That is not to say that its task was an easy one, more especially because its inception coincided with the period of greatest all-round development that British agriculture has known.

Now it is possible to look back and see what an immense amount the N.A.A.S. has accomplished. The old combination of county advisory officers, backed by specialists at the university centres, had done a wonderful piece of work, but the organization was very uneven and there were many gaps in the service it could provide. The specialist farmer or horticulturist, who lived some distance away from any area in which his type of husbandry was generally practised, could often expect little scientific assistance unless he was unusually importunate. With the greater resources and centralized direction of the N.A.A.S. this has largely been remedied, and a free advisory service of a high standard, covering the great majority of the more important branches of agriculture and horticulture and the sciences having a bearing upon them, is available to farmers throughout the land. This is a great achievement, upon which much must depend during the next few years when, as is becoming increasingly plain, we must face growing foreign competition, from which few branches of the industry will be immune.

It must seem strange to many that against this bold pattern of development of agricultural advice, another much smaller, parallel development has been taking place at the same time. In the years that have witnessed such an expansion of the free advisory service, there has also been an increase in the number of consultants in private practice, covering a wide range of farming activities. Some of them farm on their own and it is, in fact, their success at

operating some particular branch of husbandry that has led to their advice being sought by others. In contrast with them are those who have specialized in some branch of science which has a bearing upon agriculture, sometimes of limited application but in others more general. Between the two extremes, the completely practical and the mainly academic, there are those who combine both in varying degrees.

All these men must make a charge for their services, because they depend upon so doing for their living. How is it that they can do so, when there is so comprehensive an advisory service which makes no charge? And are they providing a useful service? They continue to operate, and their numbers are slowly increasing, so apparently they are, but in what ways is perhaps worthy of further explanation.

In all farming enterprises the two things that generally matter most are the man and the land; in our small islands the variety of different kinds of land is quite remarkable, yet anyone who has had to do with the farming industry must have seen that these contrasts are insignificant beside the variation in the characters of the men who farm it. Any advice that ignores this factor is doomed to failure from the outset. How often is it not the case that advice given to two men farming similar land must, of necessity, be entirely different because they themselves are so dissimilar. The more specialized the type of farming becomes, the more frequently is this the case.

A national advisory service must cater for the great majority, and must insure that they receive the service they require, and one which will prove of the greatest assistance to them. With this complex pattern of men and land, there are bound to be some whose needs fall outside those of the majority. There are those who would monopolize more of the advisory service officer's time than they are entitled to. If it is to operate efficiently, the service must inevitably work to some set of rules, yet it is among the very men who would demand more than their share of the advisory service that numbers of the most progressive farmers are to be found. It is very often the man with an active and inquiring mind who wishes to have a close and detailed study made of his farm, and who feels the need for somebody to discuss it at some length, and even write detailed reports upon the particular aspect of his farming activities that interests him most.

Relieving the pressure on N.A.A.S.

His demands may be far greater than the advisory service could possibly feel justified in meeting, yet it might well be a great loss to agriculture if they went unsatisfied. It is in such cases that the consultant can so often make a valuable contribution. There is a steadily growing interest in farm management studies; and agriculture, like industry, is beginning to recognize that this demands the critical eye of a specialist. In fruit growing, the compelling necessity for raising the quality of the product has also drawn attention to the need for examining management at every stage, to ascertain where improvements can be made, and at what cost. The whole approach to pest and disease control has undergone a fundamental change during the last few years: we know now that the routine spray programme has created problems of its own, and that sound progress must be based upon an ecological study of the beneficial as well as the harmful organisms present.

A wider interest in fertilizer practice and its effects on the nutrition of crops and livestock has led to a greatly increased demand for analysis, not only of soil samples but also of plant tissues, feedingstuffs, and so forth. In these directions, and in many others, the consultant is already helping to relieve the pressure upon the advisory service, and in a number of cases a close liaison exists between them, which enables the problems to be tackled as a piece of team-work.

There are also certain matters in which the advisory service officer would, of necessity, prefer that the independent consultant should be approached. One that has existed for as long as advice has been given in agriculture is the purchase of land, whether for some aspect of ordinary farming or for one of its more specialized branches. Another, which has grown to large proportions during the last few years, is the assessment of damage due to drifting sprays, which may often result in legal dispute. Until recently, too, the agricultural industry has lacked adequate official backing both in planning inquiries and in the committee stages of private bills in Parliament, but it has often been able to use consultants to put forward its case instead.

As their work has developed, most consultants have found the need, from time to time, to call in a specialist in a branch other than their own. Often it has been possible to pass on an inquiry to one who has been better qualified to deal with it.

Professional organization set-up

Within the small but steadily increasing band of consultants in private practice this led to the setting up of an organization that would not only deal with inquiries and pass them to the appropriate members, but also offer the public some standard of competence for their protection. The discussions upon this began as long ago as 1950, but it was not until 1956 that the British Association of Consultants in Agriculture and Horticulture was actually brought into being. Its members cover a wide range of activities in agricultural and horticultural management, as well as in forestry. These activities are by no means entirely confined to this country, nor even to the temperate regions; and they include the problems of pest and disease control, mechanization, nutrition of crops and livestock, soil surveys and land draining, to name only a few. Specialized crops under glass and in the open, fruit, hops and mushrooms, all find their place within the scheme.

It is a young organization which has, as yet, barely had time to measure the scope of the work before it, although a number of its members have been in practice for a good many years. But it has at least made a beginning of bringing them together, so that they can pool their skill and experience, and so that those seeking advice may be put in touch with an appropriate specialist. The honorary secretary is Dr. W. E. Shewell-Cooper, M.B.E., Arkley, Herts. The Association has the power to make a sound contribution to the efficiency of British agriculture; in so doing, it is not competing in any way with the existing advisory service, whose objectives it clearly shares. Instead it is hoped that each will derive advantage from the existence of the other, despite their disparity in size.

Farming Cameo: Series 2

24. North Huntingdonshire

J. C. MATTHEWS, N.D.A.
District Advisory Officer

IN a county on the edge of the fens there is always plenty of banter when farmers meet. Exaggerated virtues attributed to the fen soils by the highland farmer are vigorously denied by the fenman, and countered with examples of impossibly low rents for clay farms and astronomic prices for malting barley off the limestone. Beneath the chaff there is a measure of sympathy for each other's major problems, but surprisingly little detailed knowledge of each other's farming. Only a few holdings include both types of soil and it is unusual for a man to move from one to the other.

The fen of north Hunts was one of the last areas to be reclaimed, and some of it is still at an early stage of development. The higher parts along the gravel ridges and beside the old course of the Nene have been farmed for several centuries, but the holdings and the fields are small, with all the buildings in the villages on the edge of the highland. Farther south the holdings are larger, and though the angle of the buildings might suggest great age, this is due to the shrinkage of the peat, which has only been drained and farmed during the last hundred years.

Although the main fen drainage systems date from the middle of the seventeenth century, much of Huntingdonshire's peat land was still a bog until well after 1800. One of the last major drainage schemes was at Whittlesey Mere, in the middle of the bulge of blackland which extends westward from the Isle of Ely almost to the Great North Road. This was finally drained in 1851. To mark the occasion, the Holme Post was driven through about twenty-two feet of peat in an adjoining area of woodland, so that it would rest on the underlying clay and serve as a yardstick against which the shrinkage of the peat could be measured. Some doubt has recently been cast on the accuracy of this measurement, but the fact remains that the post is now exposed for over twelve feet below the original ground level. Beside the old post a new one now stands; a modern lamp-post mounted to give a more reliable guide. The woodland, still untouched, is a nature reserve—one of two in this area which, apart from the effects of general drainage, preserve something of the original fenland.

Deep fibrous peat, when cultivated, is subject to blowing, and in a dry spring Holme and Conington fens still suffer this tragedy. Seedling plants and fertilizer are blown off with the dry surface soil to end up in the dykes. In 1951 several fields were given about 350 tons of clay per acre to reduce the risk of blowing, and records kept since have shown that not only is blowing checked but, after the first few years, most crops are heavier and winter wheat less subject to frost damage. Just one hundred years earlier, when Whittlesey Mere was reclaimed, about the same quantity of clay was

spread on the dry bed of the Mere. It cost 3½*d.* a ton in 1851 and about 5*s.* a ton for comparable fields in 1951.

Bog oaks are a regular "crop" on this deep peat, especially on the newly reclaimed land, where it can cost more than the year's rent to remove them. Apart from the old Mere, which was alkaline, most of the land is strongly acid and requires frequent heavy dressings of lime, fortunately available only a few miles away. But to complicate the problem the old river courses, now known as silt hills, are usually alkaline, so that manganese deficiency may appear alongside acidity symptoms in the same field.

Copper deficiency was identified in this fen soon after the war, although it was generally recognized that wheat wouldn't "finish" properly on the new peats. Now it is routine practice to apply a trace of copper as a liquid spray for cereals on this particular soil, and the result is spectacular.

This is land which does best in a dry year, when its deep reserves of moisture enable plants to make full use of the sun. The top inch dries quickly after rain and, given good dykes, it is an easy working soil which can yield twenty tons of sugar beet per acre or ten quarters of wheat. It can grow weeds too, and eelworms, and unless the fenman is ready to spend his money on the land, it doesn't give the fancy income his highland friends suppose.

West of the Great North Road, boulder clay hills form most of the remaining area. Traditionally it is grazing land, too heavy to crop for long, but with more power for cultivations arable cropping has become possible. Wheat and barley are the major crops, with a fair acreage of sugar beet and potatoes. Perhaps the success of these root crops on the fen, plus the Peterborough sugar beet factory on the doorstep, has encouraged their adoption, but yields are not high enough to make them a much better proposition than well stocked leys. Good drainage is as vital to this land as to the fens, and in recent years most occupiers have carried out extensive tile and mole schemes to ensure the success of the arable crops in their ley rotation.

Beef production is probably the most popular enterprise, with dairying a close second, although the number of dairy units has been reduced by almost half in the last ten years. Most of those remaining are large herds, some with outstanding records for their breed. Sheep are most common towards the north-western edge of the county, where the boulder clay gives way to a bewildering succession of limestone, sands and gravels at the edge of the present course of the river Nene.

The stone villages are an unusual feature of this largely clay-land district; they seem even more incongruous with a large brickfield on the outskirts of Peterborough. But stone has been available here for longer than bricks and is quarried at Wansford, just within the county, both for building and as ground limestone for farm use.

This is not a county of extremes, in spite of the big difference between fen and highland. Neither can be called the best of its type, nor too difficult to farm, and both import ideas from the other, although whether the highland farmer imitates the fenman or vice versa it would not be tactful to suggest.

At the Farmers' Club

Working Methods in Mechanized Field Operations

MR. CLAUDE CULPIN, N.A.A.S. Chief Machinery Officer, told the Farmers' Club on 9th March that it is important to study working methods before deciding what farm equipment to buy. Efficiency in field work depends largely on using operational methods which have been proved, experimentally or simply by experience, to yield the best results.

Reliable information on which working methods are best is still rather limited, and where possible a detailed study of the times and labour needed to do various parts of the job is worth while. N.A.A.S. machinery officers have organized about a dozen such investigations since the war. Much progress has also been made by individual farmers. Mr. Culpin discussed their findings with reference to most of the major field operations involved in arable and grassland farming.

Sound guidance on ploughing methods is still lacking. For ploughing in lands, the continuous ploughing technique described in the Ministry's booklet *Tractor Ploughing* reduces idle running time to a minimum. Today, however, square ploughing is often preferred. To provide comparable figures for the various methods of doing this, a N.A.A.S. investigation has begun, from which useful information is expected in a year or so.

Farm tractors' horse-power has been doubled in the past twenty years, but their output of work has not kept pace. Better use of the gears could be made, and for many cultivations speeds of 3–4 m.p.h. would be reasonable. Deliberate underloading is uneconomic. Disc harrows, and the spring-tined cultivator/harrow designed for working up to 5–6 m.p.h., can provide a full load for a modern tractor, when used at sufficiently high forward speeds.

Mr. Culpin stressed the importance of carrying out cultivations so as to leave an even surface, not only for mechanized work with sugar beet but also because the speed of almost every operation with grass and corn crops is limited by the evenness of the field.

On manure carting and spreading, the main conclusions of the N.A.A.S. study made several years ago are still valid (*Farm Machinery Leaflet No. 15*); keep gang sizes to a minimum and eliminate the use of hand tools wherever possible. The exact method of working a field with a distributing machine is worth study. Mr. Culpin recommended laying out a large field in blocks corresponding to the to-and-fro spreading distance of the smallest load. Remnants of larger loads could be spread in irregularly shaped parts of the field or near the boundary. When combine drilling or potato planting, it is often convenient to refill along the field centre.

Work study investigations at the National Institute of Agricultural Engineering suggest that bulk handling techniques are unlikely to bring any great

savings on most farms. However, a Surrey farmer who formerly drilled 16 acres a day when establishing a new ley now sows 40 acres in that time, with a pendulum-type fertilizer distributor filled from a trailer of bulk loaded pre-mixed seed and fertilizer.

For root crops, accurate close hoeing has been achieved with rear-mounted, unsteered hoes using a long tool-bar fin as guide. As tractors with more clearance are developed, one-man outfits may become the rule rather than the exception. Another worthwhile development would be the one-man-operated harvester for sugar beet.

On many farms, potato picking can be greatly facilitated by using pallets for handling 5-cwt crates placed at 15–30-yard intervals. Stillage handling could probably be adapted for working with some of the newer mechanized potato harvesters.

Silage-making has received much attention, and N.A.A.S. studies in 1948, 1955 and 1958 (*N.A.A.S. Technical Reports Nos. 1, 8 and 11*) reveal the great progress made in eliminating hand-work and developing efficient methods of working with tractor-powered machines. Information is now available to help plan how best to deploy men and equipment in particular circumstances.

With most forage harvesters, cutting out the diagonal and then working round and round seems best. If wilting silage crops for twenty-four hours turns out to be desirable, as research suggests, machine design and working methods will require drastic re-assessment.

A front-mounted mower, working with a trailed swath turner, would be useful for haymaking. Working in lands after cutting the headlands for silage saves cornering troubles with side-rakes and pick-up balers. Handling bales with front and rear buck-rakes showed remarkable savings in time and labour at Compton last year. A Cumberland farmer found low-loading four-wheeled trolleys with turn-table tops, used with a bale elevator, advantageous for continuous baling, carting and stacking. An American system that delivers bales direct to a self-unloading trailer also looks attractive. Pick-up baling may become obsolete if machines for producing thin wafers or pellets of hay develop successfully.

In 1958 the sales of bagger type combine harvesters still exceeded those of tank machines, but for grain, said Mr. Culpin, "bulk handling must be the ultimate solution, and is just as appropriate to small farms as to large, the only real difficulty being the capital cost of providing the handling and drying equipment at the buildings". The best method of transporting the grain when several combines are used at once has not yet been defined. When a single grain transporter serves several combines, working in lands may be more efficient than harvesting round and round. For self-propelled harvesters, loop turns at the corners are probably preferable to cutting out the diagonals first, or driving through the crops at the corners and tidying up the remaining strips later.

"It is always important to try out new working methods to see whether some important practical consideration has been overlooked," concluded Mr. Culpin. "I hope that this paper will stimulate more comparisons between different working methods, or perhaps cause a few farmers to ask themselves whether the methods employed for particular jobs are the best available."

Sylvia Laverton

Short Guide to the Annual Review, 1960

The results of this year's Annual Review and Determination of Guarantees were published in a White Paper (Cmnd. 970)* on 10th March.

Agricultural net output this year is forecast to be 68 per cent above pre-war. The highest figure hitherto recorded was in 1957–58, when output was 62 per cent above pre-war.

The arable area has been maintained in the year under review. Thanks to the fine summer, production of cereals was a record; potatoes and sugar beet also yielded well. The drought seriously affected pastures, and reduced the yields of hay and other keep, but the hay was of excellent quality. More beef calves have been reared, and sheep numbers have continued to rise. Pig production has declined. Milk production and consumption are both increasing, and there are more eggs. Large quantities of concentrated feedingstuffs are still fed; but imports will probably be less than in 1958–59.

A new index of agricultural net output has been introduced this year, which is more closely related to the Index of Industrial Production than is the existing index. But it is not strictly comparable with the present agricultural index, and both will be published for the time being. For the new index, the average net output of the three years 1954–55 to 1956–57 has been taken as 100. On this basis, net output for 1959–60 is expected to be 116, compared with 104 last year and 105 in 1957–58.

There has been a satisfactory recovery in actual net income. The forecast for 1959–60 is £356½ million, practically the same as the record figure of £358 million reached in 1957–58. Adjusted for normal weather conditions the forecast figure is £355½ million, compared with a revised estimate of £362 million for 1958–59—again a record. (Details of farmers' net income are given in the tables on p. 45.) The total cost of agricultural support has risen to about £259 million, compared with £241 million in 1958–59.

The net increase in the cost of goods and services used in agriculture was nearly £13 million for Review commodities; this is a little more than the increases last year and the year before. Feed costs for pigs and eggs are not included in these figures, as they are reflected automatically in adjustments to the guarantees for those commodities. In the Government's view the industry's efficiency continues to increase at about £25 million a year for Review commodities.

Output has continued to expand, and the Government believe that the industry must increasingly turn its attention to reducing production costs and to getting the best returns from the market. The particular aims should be:

1. Continuing emphasis on the better production and use of grass as a means towards reducing production costs.
2. The growing of those cereal crops which are best suited to the economics of the individual farm—though barley and oats are in general to be preferred to wheat.
3. To gear milk production to a level more closely in line with requirements for liquid consumption, including the necessary reserve.
4. Reduction of the output of eggs.
5. Maintenance at present of the rate of expansion of beef production now in prospect, with continued emphasis on producing the quality the market wants, and at reasonable prices.
6. Checking the expansion of mutton and lamb, and discouraging the production of animals less acceptable to the market; and

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* H.M. Stationery Office. Price 1*s.* 3*d.* (1*s.* 5*d.* by post).

7. Securing a moderate increase in the breeding herd of pigs—but avoiding an increase to a level which would put an unreasonable burden on the taxpayer.

The total value of the guarantees has been reduced by £9 million, to a figure £10 million above the minimum assured by the Agriculture Act 1957.

Table 1

Estimated gross output of agriculture in the United Kingdom[1]

Years beginning 1st June

	1958–59	1950–60 forecast		1958–59	1959–60 forecast
	£m	£m		£m	£m
TOTAL FARM CROPS[2]	266·9	263·7	TOTAL LIVESTOCK AND LIVESTOCK PRODUCTS	1,026·5	1,042·7
Grain:			Total fatstock	447·9	440·6
Wheat	63·8	68·2	Cattle—beef	203·5	199·8
Barley	52·6	70·3	Calves—veal	4·2	4·1
Oats	10·2	11·8	Sheep and lambs—mutton and lamb	68·4	78·6
Other	0·5	0·5	Pigs—not for bacon—pork	107·4	100·0
Potatoes	94·5	66·1	Pigs for bacon—bacon pig meat	64·4	58·1
Sugar beet	32·1	34·5	Milk and milk products	335·2	343·5
Hops	7·6	6·9	Eggs[3]	159·3	161·2
Other	5·6	5·4	Poultry[4]	65·3	78·1
TOTAL FRUIT, VEGETABLES AND FLOWERS	128·7	139·6	Wool	16·6	16·9
Fruit	39·6	42·0	Other	2·2	2·4
Vegetables	69·0	77·5	Other products[5]	24·5	28·0
Flowers and nursery stock	20·1	20·1	Value of physical change in stocks on farms of crops and livestock[6]	+19·2	+19·6
			Total[2]	1,465·8	1,493·6

1. In Great Britain from holdings of over one acre only: in Northern Ireland one acre and over. 2. Includes sales of crops for feed. 3. For food and for hatching. 4. For food and for stock. 5. Includes deficiency payments for barley, oats and mixed corn not sold off farms. 6. At market prices.

Table 2

Estimated farming net income in the United Kingdom

Years beginning 1st June

	1958–59	1959–60 forecast		1958–59	1959–60 forecast
	£m	£m		£m	£m
FARMING NET INCOME	315½	356½			
TOTAL EXPENDITURE	1,250½	1,240½	TOTAL REVENUE[5]	1,566	1,597
			Farm crops[6]	266½	262½
Labour	316½	318½	Fatstock	448	440½
Rent and interest	89½	96½	Milk and milk products	335	343½
Machinery:			Eggs and poultry	224½	239½
Depreciation[1]	77	79½	Horticultural products	128½	139½
Fuel and oil	51½	51½	Other products	43½	47½
Other	91	91½	Production grants and other credits	85½	97
Feedingstuffs[2]	356	338	Increase in value at cost of farm stocks and work in progress	34½	27
Fertilizers	92	96½			
Seeds[3]	30½	28			
Imported livestock[4]	60	53			
Other expenses	86½	87½			

1. Estimated allowances on machinery and vehicles valued at replacement cost.
2. Gross value of bought feed whether home-grown or imported.
3. Imported seeds plus merchants margins on home-grown seeds.
4. Imported livestock plus transport and merchanting charges on inter-farm sales of home-bred livestock.
5. Estimates in Table 1 are here adjusted for changes in stocks awaiting sale. Includes receipts from sales of crops for feed.

Guaranteed Prices

Note: For the bases of the prices given below and other particulars of the guarantee arrangements see the Additional Details of Guarantees in Part II of Appendix VI of the White Paper (Cmnd. 970).

Table 3

LIVESTOCK AND LIVESTOCK PRODUCTS

Commodity	Guaranteed Prices 1959–60 determined after the Annual Review, 1959	Price change compared with the 1959 Annual Review Guarantee	Guaranteed Prices 1960–61 determined after the Annual Review, 1960
Fat cattle (per live cwt)	157*s.* 0*d.*	No change	157*s.* 0*d.*
Fat sheep and lambs (per lb estimated dressed carcass weight)	3*s.* 3½*d.*	− ½*d.*	3*s.* 3*d.*
Fat pigs (per score deadweight)	46*s.* 9*d.*(*a*) related to a feed price of 28*s.* 3*d.* a cwt. On the basis of the current feed price of 27*s.* 1*d.* a cwt this guaranteed price is equivalent to 45*s.* 7*d.*	+3*d.*	45*s.* 10*d.* (*a*) related to a feed price of 27*s.* 1*d.* per cwt.
Eggs—hen (per dozen)	4*s.* 0·95*d.* related to a feed price of 26*s.* 11*d.* a cwt. On the basis of the current feed price of 26*s.* 5*d.* a cwt this guaranteed price is equivalent to 4*s.* 0·53*d.*	−1·38*d.*	3*s.* 11·15*d.* related to a feed price of 26*s.* 5*d.* per cwt.
Eggs—duck (per dozen)	2*s.* 6*d.* related to a feed price of 26*s.* 11*d.* a cwt. On the basis of the current feed price of 26*s.* 5*d.* a cwt this guaranteed price is equivalent to 2*s.* 5·58*d.*	No change	2*s.* 5·58*d.* related to a feed price of 26*s.* 5*d.* per cwt.
Wool (per lb)	4*s.* 6½*d.*	−1*d.*	4*s.* 5½*d.*
Milk (average per gallon)	3*s.* 1·70*d.*	−0·25*d.*	3*s.* 1·45*d.*

CROPS

Commodity	Guaranteed Prices for 1959 harvest determined after the Annual Review, 1959	Price change compared with the 1959 Annual Review Guarantee	Guaranteed Prices for 1960 harvest determined after the Annual Review, 1960
Wheat (per cwt)	27*s.* 7*d.*	−8*d.*	26*s.* 11*d.*
Barley (per cwt)	29*s.* 0*d.*	−3*d.*	28*s.* 9*d.*
Oats (per cwt)	27*s.* 5*d.*	−3*d.*	27*s.* 2*d.*
Rye (per cwt)	21*s.* 7*d.*	No change	21*s.* 7*d.*
Potatoes (per ton)	254*s.* 0*d.* which on the new basis (note (*c*) below) is equivalent to 254*s.* 6*d.*	+5*s.* 6*d.*	260*s.* 0*d.*
Sugar beet (per ton, 16·5 per cent sugar content)	130*s.* 6*d.*	−2*s.* 6*d.*	128*s.* 0*d.*

NOTES ON PRICE TABLES

(*a*) As in 1959–60, the guaranteed price for pigs for 1960–61 in Northern Ireland is subject to a reduction of 1*d.* per score, to take account of certain expenditure incurred on pig progeny testing stations in that country.

(*b*) The guaranteed prices for fat cattle, fat sheep and wheat are average prices subject to variation seasonally; the guarantee payments for fat cattle and some fat pigs are subject to variation according to quality; and the method of calculating fatstock guarantee payments involves an element of estimation. Because the marketings of

fatstock and wheat cannot be accurately forecast, producers' average returns under the guarantees for those products in any year may be a little more or less than the guaranteed prices. The prices guaranteed to the British Egg Marketing Board for hen and duck eggs are subject to profit and loss sharing arrangements in accordance with the terms of a financial agreement between the Government and the Board.

(*c*) As a result of the change from a fixed tonnage of potatoes for human consumption in 1959–60 to a tonnage based on actual sales in 1960–61 and subsequent years, there is a slight narrowing in the definition of "sales for human consumption". On this revised basis the guaranteed price of 254*s.* 0*d.* per ton for the 1959 crop would have been equivalent to 254*s.* 6*d.* per ton.

THE MINISTRY'S PUBLICATIONS

Since the list published in the March 1960 number of AGRICULTURE (p. 575) the following publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable from Government Bookshops or through any bookseller at the price quoted.

Experimental Horticulture No. 3 (*New*) 4*s.* 6*d.* (4*s.* 11*d.* by post)
Contents include: shelter for horticultural crops; bird damage to buds of fruit trees and bushes; asparagus spacing trial; sweet corn variety trials, 1954–57; early cauliflower variety trials 1954–57; rhubarb experiments.

LEAFLETS

Up to six single copies of Advisory Leaflets may be obtained free on application to the Ministry (Publications), Ruskin Avenue, Kew, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 3*d.* (5*d. by post*).

ADVISORY LEAFLETS

No. 106. Apple Aphids (*Revised*)
No. 129. The Loganberry (*Revised*)
No. 414. Eelworms on Strawberries (*Revised*)

FIXED EQUIPMENT OF THE FARM LEAFLET

No. 20. Electricity for Farm and Estate (*Revised*) 1*s.* 0*d.* (1*s.* 2*d.* by post)

FREE ISSUES

Obtainable only from the Ministry (Publications), Ruskin Avenue, Kew, Surrey.

UNNUMBERED LEAFLETS

Farm Safety: Safety with Saws

In Brief

DEVELOPMENT GRANTS FOR EXPERIMENTAL FARM BUILDINGS

Much research has been and is being done on the basic requirements which farm buildings should supply. It has, however, become increasingly apparent that there is a lack of facilities for development work to bridge the gap between research and practical application and a need for trials of experimental buildings. Development work and trials of this kind can best be carried out on farms, which can be chosen to provide the necessary range of conditions, rather than at a research centre or centres.

To meet this situation, and at the same time to overcome the difficulty that buildings of an experimental or unproved nature would not qualify for assistance under the Farm Improvement Scheme, the Agricultural Research Council proposes to introduce a scheme of co-ordinated experiments under which grants, up to a maximum of 50 per cent of the approved cost, would be available for the erection in approved cases of experimental buildings or structures on farms or for incorporating experimental features in traditional buildings. The scheme will be administered under the supervision of the Farm Buildings Research Committee of the Council, of which Sir Walter Drummond is the chairman, and the experimental work will be under the control of the Council's Farm Buildings Unit.

In return for a grant under this scheme, the farmer or landowner by whom the building is erected will be required to co-operate with the Farm Buildings Unit in its design, and to provide facilities for its inspection and the observations required during the course of the investigation.

The scheme will be administered and the grants will be payable by the A.R.C. In no case will a grant be awarded for a building project for which a grant is being made under any other Government scheme. Experimental or unproved buildings are not in any case eligible for a grant under the Farm Improvement Scheme, where grant may only be given if the building is such as a prudent landlord would erect and is such as would clearly provide long-term benefit to the land at a reasonable cost.

It is not intended to give grant-aid in respect of all projects which comply with specified conditions, but only in respect of proposals that can suitably form part of the experimental programme of the Farm Buildings Research Committee. Applications for grant will not in any case be considered in respect of building projects which have already been started. Further particulars of the scheme, and the way in which applications should be made for grants, will be announced in due course.

Farms in England, Wales and Scotland will be eligible for grants under this scheme. It will not cover Northern Ireland.

FORWARD CREEP GRAZING

Writing in the first issue of the Durham School of Agriculture's Journal, Professor M. McG. Cooper has given some useful and succinct advice on five years' experience at Houghall of forward creep grazing for lambs. He makes a summary of eleven points:

1. Choose a pasture which has not carried lambs in the previous year, since this will minimize the risk of *Nematodirus* infection.

2. Adopt a high rate of stocking, that is at least 6–7 ewes and 9–12 lambs per acre. At low rates of stocking, the lambs do not "creep" so effectively, for there is not the incentive to do so. With low stocking, you do better to follow conventional set stocking in pastures.
3. Start lambs on the system at 2–3 weeks of age. Older lambs coming on to the system for the first time at 6–7 weeks have learned to graze with their mothers and do not use the creeps. Put up the fencing before lambing starts, so that everything is in readiness when the lambs are drafted from the lambing field.
4. The horizontal creep, a gate with a second bar from the bottom that can be moved up and down, is preferable to the creep with vertical slats that have a gap of 9 inches between them. A 15-inch gap between the horizontal bars stops most crossbred ewes and allows young lambs to go through freely. Once they have learned the habit, they will keep using the creep, even though they are almost as big as their mothers. Creeps are conveniently placed at 2½-chain intervals, corresponding to the length of a roll of sheep netting.
5. Unless cattle are also to be grazed, the fencing need consist of no more than stakes and netting, for example the type of fence used for folding roots.
6. Six paddocks appear to be the most suitable number, for it means that no paddock is grazed for more than 7–8 days and there are about 16 days of rest between grazings. The fencing should be so arranged that the paddocks can be grazed in a cycle.
7. If feed is getting ahead of the stock in a grassy year, two end paddocks can be by-passed from the grazing rotation and cut for early silage. It is important to keep the grass leafy for the lambs. They do not thrive on rank pasture.
8. Early in the season, move stock according to the needs of the ewes. When they have taken the pasture down to a reasonably low level they should be moved to avoid checking their milk supply. As the season progresses the criterion required is the needs of the lambs, and the ewes can be made to act more as scavengers.
9. Start off with a fair bite on a field which comes from winter resting and has had an early top dressing with a nitrogenous fertilizer. Nitrogen can be used subsequently should a shortage of grass warrant it, but such a course is generally unnecessary with a good clover pasture.
10. Provided a "clean" pasture is used, there appears to be no need to drench the lambs; nor is there any need to trough feed them unless they are early-born, and the aim is to meet the high-priced May market.
11. Do not use the same ground in successive years for creep grazing. With such high stock concentrations, this would be asking for trouble.

SHEEP SHEARING THE BOWEN WAY

The skill of the sheep shearer will be spotlighted when twenty-four prize-winners from eight regional sheep shearing competitions meet at this year's Royal Show, Cambridge (5–8th July). The preliminary rounds will be held at Bath, Cottesbrooke (Northants), Ipswich, Lincoln, Malvern, Salisbury, Shrewsbury and Stocksfield-on-Tyne. They are being arranged by the R.A.S.E. in association with other show societies and organizations, including the British Wool Marketing Board and the National Sheep Breeders' Association.

The three competitors gaining most marks at each regional competition will be judged in the National Finals at the Royal Show by Mr. A. E. Kidner and Mr. P. G. Williams. Competitors will be judged throughout as if they were shearing on the farm; "fancy work" will not gain extra marks. Two sheep will be sheared by each competitor at the regional events and three sheep by the finalists at the Royal Show. The maximum time allowed will be ten minutes a sheep. Electrically driven machines will be provided. Entrants for the final at the Royal Show

will be drawn entirely from the prize-winners of the eliminating contests and will be judged using their own hand-pieces.

Besides cash prizes at each regional contest offered by the organizing show societies, a further £50 will be offered to the winners at the National Competition by the R.A.S.E. Sir William Cooper, Bt., will present a Perpetual Challenge Trophy to be held by the competitor judged to be the champion shearer.

The final judging at the Royal Show will take place on 6–7th July, and Mr. Godfrey Bowen is being asked to comment on the work of the finalists. Mr. Bowen is Chief Shearing Instructor to the New Zealand Wool Board, and at one time held a world record for shearing 456 sheep in 9 hours.

Because these competitions are expected to increase interest in the Bowen method of shearing, the Royal Agricultural Society has prepared a "blow-by-blow" chart with photographs showing how the sheep should be held at each stage and with a series of drawings showing the course of every stroke with the hand-piece. This leaflet, which is considered to be the most effective attempt yet made to show the 38–42 strokes of the Bowen method, unfolds to form a wall chart so that every stage can be clearly seen at a glance.

Copies of the leaflet (price 1s., including postage), details of the competition and entry forms may be obtained from the R.A.S.E., 35 Belgrave Square, London, S.W.1.

NATIONAL GRASSLAND DEMONSTRATION

Grass will be in the news on 8–9th June when a National Grassland Demonstration takes place at Mr. Rex Paterson's Hatch Warren Farm, Basingstoke, Hants. It will be opened by Lord Waldegrave, Parliamentary Secretary (Lords) to the Ministry of Agriculture. The demonstration is a sequel to the National Silage Demonstration, which was seen by over 22,000 visitors when it was held on the same farm in May 1958. It is again being sponsored by Shell Chemical Company.

The National Grassland Demonstration will include field demonstrations of systems of making silage, using various types of forage harvester; haymaking methods, including artificial drying; and fertilizer application with different kinds of distributor. There will also be an advisory exhibit and an exhibition of static machinery.

The aim of the demonstration will be to emphasize the value of grass as a crop and to give practical examples of how yields can be increased and how grass can be conserved economically for winter use. A wide range of machinery manufacturers will be taking part.

The Advisory Committee, responsible for organizing the demonstration, has been drawn from the Ministry of Agriculture, the N.F.U., the N.I.R.D., the N.I.A.E., the M.M.B. and Shell Chemical.

THE FARMER AND HIS BANK

A new colour film with the above title has been produced by the Midland Bank to show the advantages to farmers of discussing their affairs with their local bank manager, and the special services that the Midland Bank offers to farmers. The film, based on fact, shows how the Bank finances a young farmer who, on taking over a run-down holding, plans stock and cropping changes and improvements to buildings with the help and advice of his local N.A.A.S. officer.

Showings of *The Farmer and his Bank* can be arranged by the manager of any branch of the Midland Bank, and the film is also available through the film library service of Sound-Services Limited, Guild House, Upper St. Martin's Lane, London, W.C.2. It is 16 mm and runs for 21 minutes.

Book Reviews

Diseases of Farm Crops. A. BEAUMONT. Collingridge. 25*s*.

Mr. Beaumont's new book is uniform with his other successful volume, *Diseases of Garden Plants*. It contains an account of the main groups of plant diseases and of the principles of control, followed by concise sections on most of the diseases found in Great Britain on cereals, potatoes, root and fodder crops, legumes, grasses and a few market-garden crops.

The author's name has passed into scientific language in the term "Beaumont periods", the critical weather periods leading to potato blight epidemics: he is a specialist in potato diseases as well as in diseases of flowers. The section dealing with potatoes is, therefore, the most detailed and interesting. Nevertheless, much care has been taken to make the other sections as informative as possible. Clear descriptions are given of symptoms, so that the grower can usually be fairly sure of the identification of the disease—though in critical cases the N.A.A.S. should be consulted. The suggestions on control measures are concise, practical and embody the latest information available at the time of going to press.

In some cases new knowledge has come forward since then, or there has been a change in recommended practice. Thus it is now thought unsafe to feed cereal seed treated with organo-mercury seed dressings, even though previously washed, to poultry; and sodium arsenite has been banned as a potato haulm destroyer after 1960. Liquid dressings for cereal seeds have been introduced which, applied by merchants equipped with special machines, reduce the dangers inherent in the use of toxic dusts. Hexachlorobenzene apparently does not control *Septoria* spp. on wheat seed, and failures of stand may result when this material is used.

The virus disease cereal yellow dwarf now appears to be fairly common, at least in the south of England, and more practical attention may have to be paid to this and other cereal virus diseases. Also, take-all and mildew probably cause more economic loss than is suggested. Most of the wheat varieties indicated as resistant and susceptible to yellow rust are now superseded, as are the barley varieties given as susceptible to loose smut. It is highly improbable that black rust of wheat overwinters in the uredospore stage in England. Some changes have been made in the areas in which potato seed may be grown for A certificates: the Cotswolds are not now included.

The book is indicative of the very large amount of information accumulated on plant diseases in recent years, especially on the epidemiological and control sides, much of it by N.A.A.S. specialists. It will be in demand equally by students of plant pathology and of agriculture generally, and should be in every library concerned with these subjects.

L.O.

Cockle Park Farm. An Account of the Work of the Cockle Park Experimental Station from 1896 to 1956. H. CECIL PAWSON. Oxford University Press. 35*s*.

Cockle Park! The mere name conjures up visions of those famous pioneers, Somerville, Middleton and Gilchrist, of famous fields like Tree Field, Hanging Leaves and Paradise Land and of famous facts which came from them. These are the men and the fields which first established the vital knowledge concerning the influence of phosphates, of the grazing animal and the use of the plough in securing high grass output. What a debt we farmers owe to this place and to these men and indeed to all the staff at Cockle Park who, since 1896, have toiled with meticulous endeavour, by experiment and record, observation and deduction, to unravel for us the profound secrets of good grassland husbandry. And what a debt we owe now to Professor Pawson, who, following in the same painstaking tradition, has faithfully recorded the full story.

Sir John Russell's foreword puts the whole fascinating story in true perspective, and it is well to remember that on probably no other farm in the world are the different stages in improved grassland

management so clearly revealed; and no series of trials over the last half-century has done more to create the changed concept of grass as a crop. As a generation we are apt to be pretty self-satisfied with our achievements, and it is salutary to read the following advice being offered to farmers in 1893: "It pays (by using basic slag) to feed grasses with nitrogen in pastures to get an early bite on land which has just been got to grow clovers abundantly".

Appropriately, the first chapter is a cameo of the principal historical figures, Somerville, Middleton and Gilchrist, which is finely and tenderly drawn by the author. Somerville had good business acumen, and even way back in 1897 he was recording his results visually and strikingly in *economic* terms; his diagrams of the results from the Tree Field Pasture Plots are a model for today when the slogan "advertising pays" is in common usage.

Although it was Tree Field with its manurial trials that first won fame for Cockle Park, it is surely Gilchrist's work on seeds mixtures, culminating in the well-used "Cockle Park" ley mixture for three years or permanent pasture which has secured a lasting place in farmers' memories and practice. The many seedsmen's catalogues still including this mixture testify to that; and agricultural students all over the country will recall the question in their finals which require them to outline and comment upon this successful prescription.

The emphasis on grass at Cockle Park has tended to overshadow the equally good work accomplished in the realm of arable cropping. I was glad to see that the author has taken the opportunity to remedy this state of affairs by devoting comprehensive chapters to rotations and arable cropping. Nor does he neglect the livestock breeding and feeding trials.

It is no exaggeration to say that the work at Cockle Park has had an immense impact on world agriculture. It was begun in a modest way by far-sighted men and was continued through the decades with little in the way of facilities or finance compared with the demands of modern research workers. This in itself is a sobering thought for us. It is also an example of painstaking, methodical investigation which should be a stimulus to young agriculturists, both academic and practical, for years to come.

Yes, here is a clear, faithful account of achievement at a famous farm, perfectly executed by one with forty years' experience of the farm and its attendant problems. *Cockle Park Farm* merits a place in all agricultural institutions, whilst advisers, research workers and farmers everywhere will find within its pages a fund of useful information.

H.I.M.

Handbook of Animal Breeding, Vol. 2, Genetics of Domestic Animals. Edited by J. HAMMOND, I. JOHANSSON and F. HARING. Paul Parey (Hamburg and Berlin). 98 *D. Marks.*

As a worthy successor to the first volume in the series, this book has carried further the attempt to increase international co-operation towards scientific stock-breeding. Alan Robertson and H. B. Carter of Edinburgh join the team of contributors, which also includes four distinguished Swedish geneticists, three Swiss, three German, one Norwegian and one American authority.

The first hundred pages cover a historical review, general modern genetical theory following Mendel, and a chapter on population genetics. In the second part, the work goes into considerable and very interesting detail on the inheritance of each of various individual properties of the domestic species, such as coat colour, blood groupings, defects, disease resistance, fertility, milk, meat, wool and egg yield. Reference is also made to work concerning fur-bearing species, and it is pleasant to see adequate recognition that the horse is still an animal of great economic importance in a soundly organized agricultural system. Practical methods of animal improvement are dealt with in the third part, and the book ends with a chapter reviewing outstanding results already achieved.

No previous knowledge of genetics on the reader's part is assumed, so that the book can be used by undergraduate agriculture and veterinary students, if they read with discrimination. The keenest among them will find it a treasure-house of information, and no one whose work has any connection with animal husbandry could fail to profit by having a reference copy constantly available.

The reference lists supplied indicate a more generally representative scrutiny of world literature than was the case in part of the first volume in this series. They

also indicate that most of the published work drawn upon, even by the German-speaking authors, is in English; and it seems to me that this book would reach a much wider public if it had been published in that language, instead of in German. In any event, its merits would justify publication in more than one language.

F.L.M.D.

Polythene Film in Horticulture. H. R. SPICE. Faber and Faber. 18*s*.

Mr. Spice is a recognized authority on the use of polythene film in horticulture, and now he has concentrated his knowledge and experience into a comprehensive book. His account is written with enthusiasm, but is well balanced and fair. The disadvantages of his material, such as deterioration under ultra-violet radiation, are clearly discussed, and where necessary he compares polythene with polyvinyl chloride, the other film in fairly common use.

The established use of plastic film in glasshouse lining is explained in detail, and the author goes on to discuss polythene film as a substitute for glass. He describes the efforts that have been made to build greenhouses of this material, and the chapter will provide a good starting point for anyone considering the use of plastics on forcing structures.

Plastic film has not yet proved itself in place of glass, but there is no doubt that in time a suitable film will be found, and the pioneering trials described by Mr. Spice will be of great value. He makes the important point that traditional ideas of glasshouse construction should be discarded when dealing with plastic film. This is true, but the houses he describes are in fact traditional light-weight structures using film instead of glass; the revolutionary design, making full use of the lightness and pliability of this new material, has not yet appeared.

There is an interesting section on plastic cloches, frames and tunnel covers. All these have considerable commercial value, tunnel covers, in particular, are used in many parts of the world, and represent the most important step towards the recognition of film as a new material requiring new techniques. The author emphasizes that temperatures are lower at night in plastic greenhouses and cloches than in glass structures, because plastics, particularly polythene, offer little resistance to the outward passage of long-wave radiations at night. In the production of many crops this is not a serious disadvantage; Dutch lights offer only 5°F maximum temperature lift after a sunny day, and practically none after a cloudy one. Thus the night air temperatures in March will often be well below the threshold temperature for growth of lettuce and, indeed, frequently below freezing. Certainly the night temperatures under plastics will be slightly lower than those under lights, but it is the lifting of the day maxima and the quick rise above the threshold temperature which give the forcing effect on temperate crops in spring.

Other important uses of plastics mentioned are propagation, plastic reservoirs, the development of lay-flat tube for irrigation and the distribution of warm air in glasshouse heating, and a variety of lesser uses too numerous to mention here.

This is a well illustrated and comprehensive reference book and as such will be welcomed by all those interested in modern developments in horticulture. It would be difficult for any grower to read this volume without picking up ideas for the more efficient running of his holding: ideas as diverse as the storage of bud sticks in plastic bags, or the building of cucumber beds on film to prevent infection from below.

A.A.J.

Farm Rents and Tenure. J. T. WARD Estates Gazette. 15*s*.

In ninety-five pages Mr. Ward discusses the determinants of farm rents; the landlord-tenant system over the last 100 years; movements in average farm rents between 1939 and today; the effect of the security of tenure given by the Agricultural Holdings Acts on farm rents, farm sale-values, and investment by landlords; the likely impact of the 1958 Agriculture Act; and the comparative advantages of such arrangements as a free market for rents, long leases, owner-occupiership, and nationalization. The chief original contribution is the useful time-series, derived from auction-sale results, of the gross yield of tenant farms as investments, and of movements in the sale value of farms with and without vacant possession.

What Mr. Ward says otherwise is fairly familiar to anyone with a previous interest

in these matters; to newcomers it will show how the legal and economic circumstances which govern relations between landlords and tenants are viewed by current enlightened opinion. Mr. Ward's main concern is for the most productive use of resources. He regards the landlord-tenant system as the best way to achieve this—if landlords are able and willing, broadly, to let holdings to those tenants who can farm them best, and whose capacity to pay high rents will improve landlords' ability and incentive to invest. He suggests that the relaxation of the market brought about by the 1958 Act will help to this end.

On a minor point, one cannot accept without question the suggestion that there has been a substantial deterioration of landlords' capital, which needs to be made good. The fact that the volume agricultural output per person working is at record levels hardly implies that there is a lack of associate capital resources; nor can the apparently relatively moderate returns to additional investment easily be reconciled with the implication of a "lack of capital". Some changes in recent years have in fact made landlords' capital less necessary. Thus the fall in the numbers of workers, and the growth of local authority housing have reduced tenants' requirements of farm cottages. Similarly, the real cost of garaging a tractor is small compared with that of adequately housing the teams of horses of the same ploughing capacity.

G.S.

Cambrian Forests (Forestry Commission Guide). Edited by H. L. EDLIN. H.M. Stationery Office. 5*s*. (5*s*. 6*d*. by post).

Naturalists, country-lovers and all who contemplate visiting this charming countryside will find this addition to the Forestry Commission Guide series fascinating reading. It is a collection of articles by well-known specialists in agriculture, forestry, history, geology, botany and wild life.

The tree species planted in the various forests are listed, and data of the size, location and stage of production of each forest are included. The part played by the large estate owners in re-afforestation during the late eighteenth and early nineteenth centuries is discussed.

The agriculture of mid-Wales and the farming systems practised are reviewed. Dr. R. Phillips explains how the co-existence of farming and lead mining brought prosperity to the area, and speculates that future prosperity "must rest upon the mutual support of the twin industries of agriculture and forestry". There is an all too brief glimpse into the way of life of the inhabitants of mid-Wales, from the distant past to comparatively recent times. Places of interest referred to include cromlechau, carneddau, hill forts, hut dwellings, churches, abbeys and castles.

Comprehensive sections are devoted to geology and botany, but they may be of more interest to students of these sciences than to the average reader. Mid-Wales is rich in wild life, and a wealth of information is given about well-known and rare animals, birds, reptiles, fish and insects. A very full list of well- and lesser-known plants, trees, mosses and ferns, showing where these can be found, is also provided.

The authors have not forgotten to include details of tours and walks of interest, rail and bus routes, footpaths, and a list of hotels and hostels from which this magnificent countryside can be explored. Mention must be made of the large collection of panoramic photographs, as well as of the delightful drawings which head each chapter.

D.S.D.

Store Cattle and Store Sheep Rearing in Devon and Cornwall, 1955–56 and 1956–57. (University of Bristol, Department of Economics Report No. 113.) E. T. DAVIES and H. W. B. LUXTON. 5*s*.

The first part of this report deals with the physical and historical aspects of rearing stores in the two counties. It also traces the trends in sheep and cattle population up to the present day, and the factors which have influenced these trends.

Then follows general information about 54 farms from three areas. These are divided into three groups—better land, poorer land and moorland farms; the first being mainly in South Devon, and the other two in the Exmoor, Dartmoor and Bodmin Moor areas. Farm size ranged from 50 to 300 acres, but the average in the three groups is very much the same. Cattle and sheep enterprises are considered separately and then together in relation to output and financial aspects and various efficiency measures.

Many interesting facts are discussed in the summary, which is, of course, the kernel of the report. According to the summary, probably the greatest single influence in the sheep enterprise was the prolificacy of the ewe flock. This is of great interest when considering some recent trends in other livestock enterprises.

The report contains 57 tables from which much useful information can be obtained. In these days of competition, when the emphasis in all agricultural enterprises is on reducing output costs, it is useful to be able to study in detail the various factors which can contribute to this end. This is a most valuable report, which well pays for the time spent in a critical study of all the facts and figures presented.

A.T.G.T.

A Bibliography of Farm Buildings Research, 1945–1958. Part 1: Buildings for Pigs. Agricultural Research Council. 2*s.* 6*d.*

Reports of scientific work are published in many countries and, as some seldom appear outside their own domain, it is becoming more difficult for anyone interested to keep track of work done in his particular subject. Such was the position with research work in relation to the physiological requirements of pigs.

As any design in pig housing must start with the facts of physiological requirements, it follows that many houses were built which were quite unsuitable—because the designers were unaware that any work on this subject ever existed. Clearly then, any attempt at rational design must be preceded by gathering together the known facts.

Mr. Nigel Harvey, working under the auspices of the Agricultural Research Council Farm Building Unit, was given the unenviable task of collating this work into a bibliography for the period 1945–58. This is now available, and includes the findings of scientific research, investigations, field trials and development phases of new techniques. Abstracts from the original material are given, together with a review summarizing the main conclusions. This invaluable bibliography is to be followed by similar ones covering other sections of work relating to farm buildings.

At last design will be based on knowledge, and not on uninformed opinion.

H.H.

PIDA Second Annual Report (Year ended 30th September, 1959). 1*s.*

The Pig Industry Development Authority, which was set up in 1957, has issued its second report and statement of accounts. The report describes the Authority's activities in various aspects of its statutory functions, which include pig recording, accreditation, progeny testing, grading and artificial insemination. During the year the Authority has taken over full responsibility for the Premium Boars' Scheme. Publicity for British bacon, pork and pork products by the newly formed PIDA home service is making its impact by posters, films, lectures and exhibits at agricultural shows.

The report is available from the Authority at PIDA House, Ridgmount Street, London, W.C.1.

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H.Y. NUTS

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